WETLAND

A Proposed Wetland Restoration Project - Lake St. Clair

Final Report

"A socio-economic and environmental effects study of a proposed 1000 acre wetland restoration project near Lake St. Clair, in Southwestern Ontario"

Prepared for

EHJV·PCHE
EASTERN HABITAT JOINT VENTURE
LE PLAN CONJOINT DES HABITATS DE L'EST
ONTARIO
Lake St. Clair Technical Committee

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April 2001

Executive Summary

Ontario's wetland habitats are critical to the survival of over 142 species of birds, 53 species of fish, 20 species of mammals, 19 species of amphibians and reptiles, and 350 species of plants. Of these, 17 species are included in the Ontario Endangered Species Act; and many are associated with wetlands located in the Carolinian Zone of southwestern Ontario.

The wetlands of the Lake St. Clair area are internationally recognized as being of continental significance to hundreds of thousands of waterfowl, shorebirds, and songbirds that migrate through the area twice a year on their way to and from winter habitats in the south and breeding habitats in the north. The importance of these wetlands stems from the fact that they provide important feeding and resting habitats at a critical location along the Mississippi and Atlantic (migratory) flyways.

The Eastern Habitat Joint Venture (EHJV) has identified the Lake St. Clair area as one of Ontario's top priorities for migratory waterfowl habitat conservation.

The Eastern Habitat Joint Venture (EHJV) has identified the Lake St. Clair area as one of Ontario's top priorities for migratory waterfowl habitat conservation. Through this study, the Lake St. Clair Technical Committee of the EHJV has investigated the possible socio-economic and biological implications of undertaking a wetland restoration project of approximately 1,000 acres in the vicinity of the Canadian portion of the Lake St. Clair shoreline. The primary goal of the restoration project is to increase the availability of waterfowl staging habitat within approximately 8 km of the Canadian shoreline of Lake St. Clair.

The general purposes of this study are to determine:

- The environmental, economic, and social effects of the restoration project of these 1,000 acres of wetland habitat
- How the benefits identified as part of this study could be applied to similar wetland proposals

The objectives of this study are to identify:

- The economic and social effects that the restoration of a wetland of this size will have on the local area (and other scales, e.g. regional), including but not limited to agriculture, tourism, and recreation
- The environmental benefits on local, regional, and continental scales of restoring a wetland in this type of landscape and socio-economic setting

Conclusions

The results of the analyses clearly suggest that the proposed wetland restoration project would provide substantial environmental and social benefits. They also suggest that the economic downside of the project is negligible and that there is a reasonable basis for expecting modest economic benefits. Accordingly, the EHJV partners and the Municipality of Chatham-Kent should consider moving forward with the initiative at the earliest opportunity.

> ***The EHJV partners and the Municipality of Chatham-Kent should consider moving forward with the initiative at the earliest opportunity.***

A key step in the methodology of the study was a comparative analysis of other restored wetland sites. Seven sites located in Michigan, Ohio, New York, and Ontario were selected based on their potential comparability to the EHJV project and their ability to provide a range of acquisition and management experiences. Restoration of wetland habitat was a key aim in the development of each of the seven sites.

The comparative analysis highlights the following characteristics:

- Management objectives
- Activities, services, and facilities provided
- Waterfowl, other wildlife, and wetland management
- Visitation, promotion, and economic impacts
- Relationships with surrounding landowners
- Staffing and budgets

An evaluation of the results of the comparative analysis was used to develop estimations of budgets, economic impacts, social impacts, site visitation levels, and recreational opportunities which may occur at the proposed restoration site.

Current wetland mapping from the Ontario Ministry of Natural Resources (OMNR) shows the wetland area in the Study Area to be approximately 4,806 acres. This figure varies considerably due to the fact that varying lake levels affect a large percentage of the coastal wetlands.

Restoration of a 1,000 acre wetland would increase the area of wetlands in the Study Area by approximately 21 percent. The restoration project will likely consist of three to six wetland cells separated by dykes.

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The design and management of the restored wetland will focus primarily on maximizing benefits to migrating waterfowl. It will benefit continental and regional waterfowl populations primarily by providing high quality Spring and Fall staging habitat for resting and feeding, which will improve the health and increase the chance of survival of migrating waterfowl.

It is not known with certainty whether the wetland would simply redistribute waterfowl currently using the area or if it would generate additional waterfowl stopovers; however, it is anticipated that additional wetland habitat will increase the number of migrating waterfowl using Lake St. Clair area as a stopover.

Incorporation of ancillary compatible habitats has the potential to significantly augment local biodiversity and greatly increase the socio-economic benefits of the project.

The primary purpose of the restored wetland will be as a feeding and resting area for migrating waterfowl; however, it is apparent that the incorporation of ancillary compatible habitats has the potential to significantly augment local biodiversity and greatly increase the socio-economic benefits of the project.

Additional habitat types which could be included in the restoration project include:

- Mudflat
- Tallgrass Prairie
- Swamp
- Woodland

Restoration of all of the proposed habitat types could more than double the total biota in the area to 804 species. Of the 534 additional species provided for by the restored habitat types, 135 are animals and 399 are plants. Twenty of the additional animal species and 39 of the plant species are considered rare. Of course, each of the various habitat types is associated with a group of species not found in any other habitat type. The shallow marsh and associated upland dykes, which will cover most of the restored area, will account for half (269 or 50 percent) of the new species. Swamps could add 91 (17 percent) additional species to the area and tall grass prairie could add 72 (14 percent). The remaining 102 species (19 percent) could be contributed through upland woodland habitat.

Additional recreation opportunities including birding and nature viewing and hunting, will be provided by the restoration of wetland habitat.

Additional recreation opportunities including birding and nature viewing and hunting, will be provided by the restoration of wetland habitat. The proposed basic wetland design alone will draw visitors, but incremental increases in biodiversity through the creation of additional habitat (e.g. mud flats to attract shore birds or grasslands) will likely increase visitation.

The restored wetland would add approximately 500 hunter days per season.

The local consensus is that there are too few sites to satisfy local demand for hunting; therefore, the proposed wetland is welcomed as a development that will help meet this demand. The restored wetland would add approximately 500 hunter days per season.

The total economic effect from new recreation expenditures associated with the restored wetland is estimated to be $200,000 to $430,000, annually. Total recreational user value (based on a "Willingness to Pay" approach) for the restored wetland is estimated to be $130,000 to $330,000, annually.

The economic effects of the wetland are directly related to attracting users to the site. Factors affecting human use of the site include the variety of habitat types, range of recreational opportunities, and the quality of the onsite facilities. The following variations on the basic options were evaluated: base case (marsh habitat with minimal facilities), mudflats (base case plus additional shorebird habitat), and interpretive centre (base case, several other habitats plus interpretive faciities).

While a specific site has not yet been selected for the new wetland, it is clear that 1,000 acres (405 ha.) of land will be acquired for the proposed facility. Intensive cropping is the predominant land use within the study area, with little idle land in evidence and virtually no livestock activity. All of the land to be acquired for the new wetland is therefore assumed to be arable farmland producing cash crops that are representative of the area.

The displacement of 1,000 acres of agricultural land implies a total annual loss in gross farm sales of $430,000 for a corn/bean rotation or $1,700,000 for a vegetable rotation. The corresponding losses in net farm income are $149,000 and $571,000, respectively. Depending on the proportion of cropping systems that are displaced, the actual losses will lie between these limits.

The cost of site land is expected to range from $3.7 to $4.5 million. This money is expected to go to farm families and to be used by these families to create annuity funds for retirement. Proceeds from the resulting retirement funds represent new household income amounting to $329,000 annually. Expenditures from this retirement income will, in part, offset the adverse economic impact of the loss of farm income discussed above.

From the perspective of business performance, it appears that a restoration project including an additional mud flat habitat is the best option in terms of the highest expected net operating income and the lowest risk of loss. The assessment of net public benefit suggests that the inclusion of an interpretive centre has the highest net economic benefit, even after risk is taken into account. The interpretive centre option also shows the best performance in terms of impact on economic activity, with only a small chance that a loss in activity might occur with this.

The assessment of net public benefit suggests that the inclusion of an interpretive centre has the highest net economic benefit.

These results imply that an optional business strategy would entail the initial development of the mud flats. If something resembling the interpretive centre is eventually desired because of the public benefits that it creates, then such a centre could be developed more gradually building on the experience and knowledge gained by running a more modest facility. Such an approach might also allow time to assess the impacts of increased use of the facility on the ecology of the wetland and the ecological benefits that are expected.

Social impacts of the project are positive and significant.

Social impacts of the project are positive and significant. The restored wetland will generate significant new recreational opportunities on publicly accessible land throughout most of the year. The findings of this study suggest that the potential for negative effects is negligible and would be limited to possible nuisance impacts such as trespassing, litter, noise, and parking/traffic issues. None of these issues were noted as being significant in the minds of local residents, either during this study or in the Phase I consultations, but were apparent at some of the comparative sites. The issues are easily controlled with proper site/facility design and management.

Crop damage resulting from waterfowl depredation was identified as a concern during the Phase I consultations. The finding of this study suggests that, should the project proceed, this should not be a significant occurrence.

A restored wetland in the Lake St. Clair area would be a very attractive opportunity for local educators. It is estimated that elementary schools in the Chatham-Kent region take 55 to 70 field trips annually which have an environmental focus. Assuming that there are 25 students per trip, this involves 1,400 to 1,750 students. If this assumption is applied to the seventeen elementary schools in just the Kent portion of the St. Clair Catholic District School Board, then there would be 35 to 40 environmentally focussed school trips annually that would involve 900 to 1,000 area students.

Summary

The combined environmental, economic, and social effects of the proposed project are positive and significant. The restored wetland will:

- Increase waterfowl staging habitat
- Increase local biodiversity
- Increase local hunting opportunities
- Increase local recreational opportunities
- Have a negligible economic effect
- Have positive public benefits
- Enhance local tourism potential
- Provide education and research opportunities
- Contribute to local cultural heritage
- Restore critical habitat within the Great Lakes ecosystem

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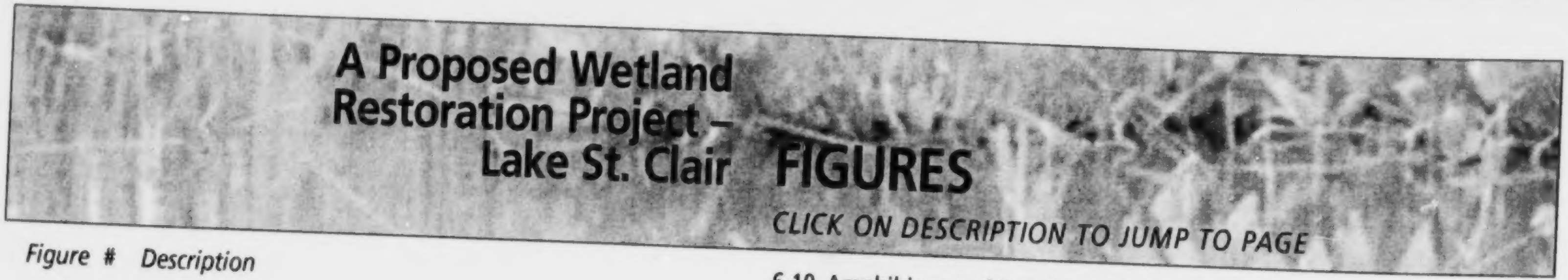

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"A socio-economic and environmental effects study of a proposed 1000-acre wetland restoration project near lake St. Clair in Southwestern Ontario"

FINAL REPORT

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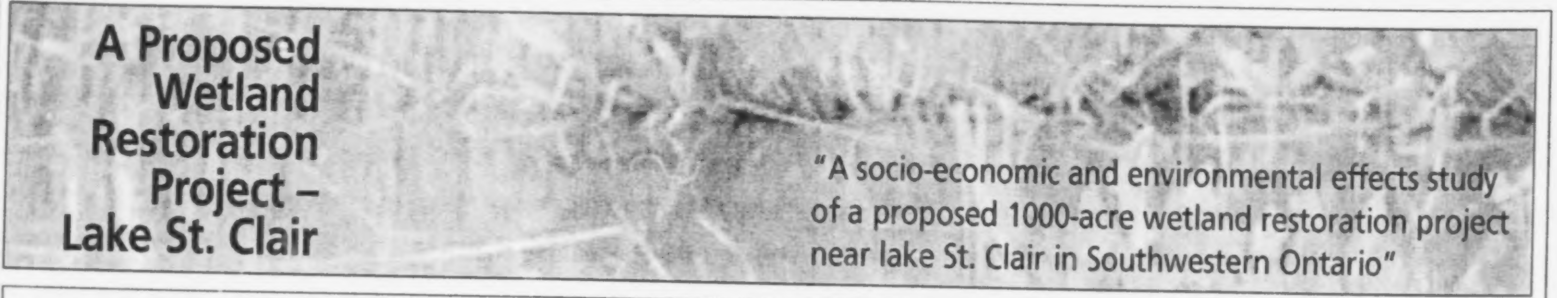
This report was prepared under the direction of several partners in the Ontario Eastern Habitat Joint Venture (EHJV) program. The EHJV is one of 14 habitat joint ventures established across the continent under the auspices of the North American Waterfowl Management Plan (NAWMP). More information on the NAWMP can be found at http://www.nawmp.ca

Pages in the sections are oriented vertically for ease of printing. Pages can be viewed horizontally on-screen using the "rotate view" icon available in the enhanced Acrobat "Reader with Search" – a free download from http://www.adobe.com/products/acrobat/alternate.html



A Proposed Wetland Restoration Project – Lake St. Clair

"A socio-economic and environmental effects study of a proposed 1000-acre wetland restoration project near lake St. Clair in Southwestern Ontario"

FINAL REPORT

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1. Introduction

1.1 Background

Ontario's wetland habitats are critical to the survival of more than 142 species of birds, 53 species of fish, 20 species of mammals, 19 species of amphibians and reptiles, and 350 species of plants. Of these, 17 species are included in the Ontario Endangered Species Act; many are associated with wetlands located in the Carolinian zone of southwestern Ontario.

Natural wetland

Wetlands are of critical importance as breeding habitat and migration stopovers for waterfowl and a wide variety of other migrating birds, most notably shorebirds. In the spring, migrant birds stop on the way to arctic, subarctic, western, and northern breeding areas. In the fall, migrant birds returning to wintering grounds in the eastern and southern parts of the United States, Mexico, and South America make extensive use of traditional Ontario staging areas (i.e. 68 million waterfowl-use days per year). The lower Great Lakes shoreline and the coasts of Hudson Bay and James Bay are particularly important staging areas, providing feeding and resting habitats at critical locations along the Atlantic and Mississippi migratory flyways (Eastern Habitat Joint Venture, 1994).

Roughly 90 percent of the wetlands that existed in the Lake St. Clair area prior to European settlement have been lost to various forms of development.

Wetlands and agriculture are fundamental elements of the natural and cultural heritage of Kent, Lambton, and Essex counties. However, roughly 90 percent of the wetlands that existed in the Lake St. Clair area prior to European settlement have been lost to various forms of development.[1] Snell (1986) estimated the pre-settlement wetland area of the three counties to be 1,109,500 acres. By 1982, 90 percent of this wetland area had been lost, mostly to agricultural development. In the Municipality of Chatham-Kent, wetlands currently represent less than 4 percent of total land cover, compared to about 64 percent in pre-settlement days. Only a small portion of the original area of marsh and wet meadow remains along Lake St. Clair.

Due to the substantial loss of natural wetland, the Eastern Habitat Joint Venture has identified the Lake St. Clair (LSC) area as one of Ontario's top priorities for migratory waterfowl habitat conservation (Eastern Habitat Joint Venture, 1994).

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[1] Specific losses in the Lake St. Clair area are discussed in more detail in Section 6.1.

1.2 Eastern Habitat Joint Venture Program

The Eastern Habitat Joint Venture (EHJV) is one of 14 habitat joint ventures established under the umbrella of the North American Waterfowl Management Plan (NAWMP). The NAWMP is a significant partnership initiative undertaken by the conservation community. Initiated in 1986, the NAWMP is an agreement among the governments of Canada, the United States, and Mexico aimed at ensuring the survival of and increase in waterfowl populations and the protection and conservation of wetland and associated habitats across the continent. The NAWMP combines the resources of federal, state, and provincial governments with those of non-government organizations for joint projects.

The EHJV covers significant portions of Ontario, Quebec, and the Maritime provinces. The goal of the EHJV is to protect, restore, and enhance wetlands in eastern Canada.

In Ontario, the EHJV is a partnership of seven agencies that work together to influence, secure, enhance, and manage wetlands in the province. These agencies are:

- Ontario Ministry of Natural Resources
- Canadian Wildlife Service, Environment Canada
- Ducks Unlimited Canada
- Wildlife Habitat Canada
- Ontario Ministry of Agriculture, Food & Rural Affairs
- Nature Conservancy of Canada
- Agriculture and Agri-Food Canada

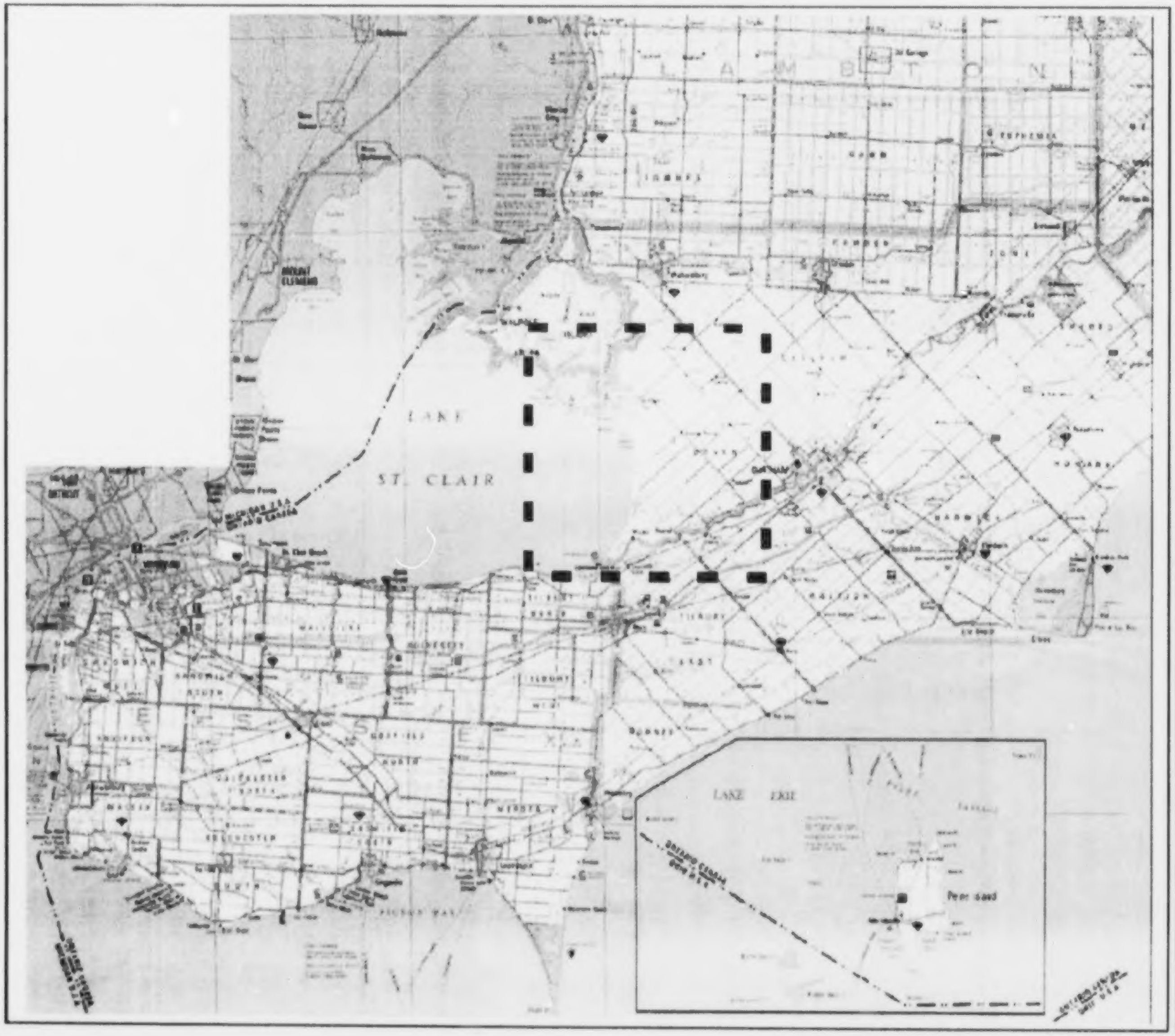
The EHJV recognizes that a number of tools can be employed to assist in achieving the desired outcomes identified in its Implementation Plan (Eastern Habitat Joint Venture, 1994). The Lake St. Clair area wetland restoration project is one of those tools.

1.3 Overview of the Proposed Undertaking

The EHJV, through its Lake St. Clair Technical Committee (LSCTC), is investigating the possibility of undertaking a wetland restoration project of approximately 1,000 acres in the vicinity of the Lake St. Clair shoreline, as shown in Figure 1-1. The primary goal of the restoration project is to increase the availability of waterfowl staging habitat within approximately 8 km of the Canadian shoreline of Lake St. Clair. (The project concept is described in more detail in Section 4.)

The Lake St. Clair area has been identified by the EHJV as one of Ontario's top priorities for migratory waterfowl habitat conservation.

As currently envisioned, the restored wetland would consist of the reconversion of agricultural lands into a number of wetland habitat cells. While the design and management of the restoration project would focus primarily on maximizing benefits to migrating waterfowl, serious consideration is also being given to incorporating ancillary habitat


LAMBTON
LAKE ST. CLAIR
ESSEX
LAKE ERIE
Pelee Island

Legend

▭ General Study Area

Project 116800 TT 01	**Date** Jan. 2001	
Scale NTS	**Drwn/Chkd** JPC / SND	

Figure 1-1

Study Area - Regional Settings

19620 figure

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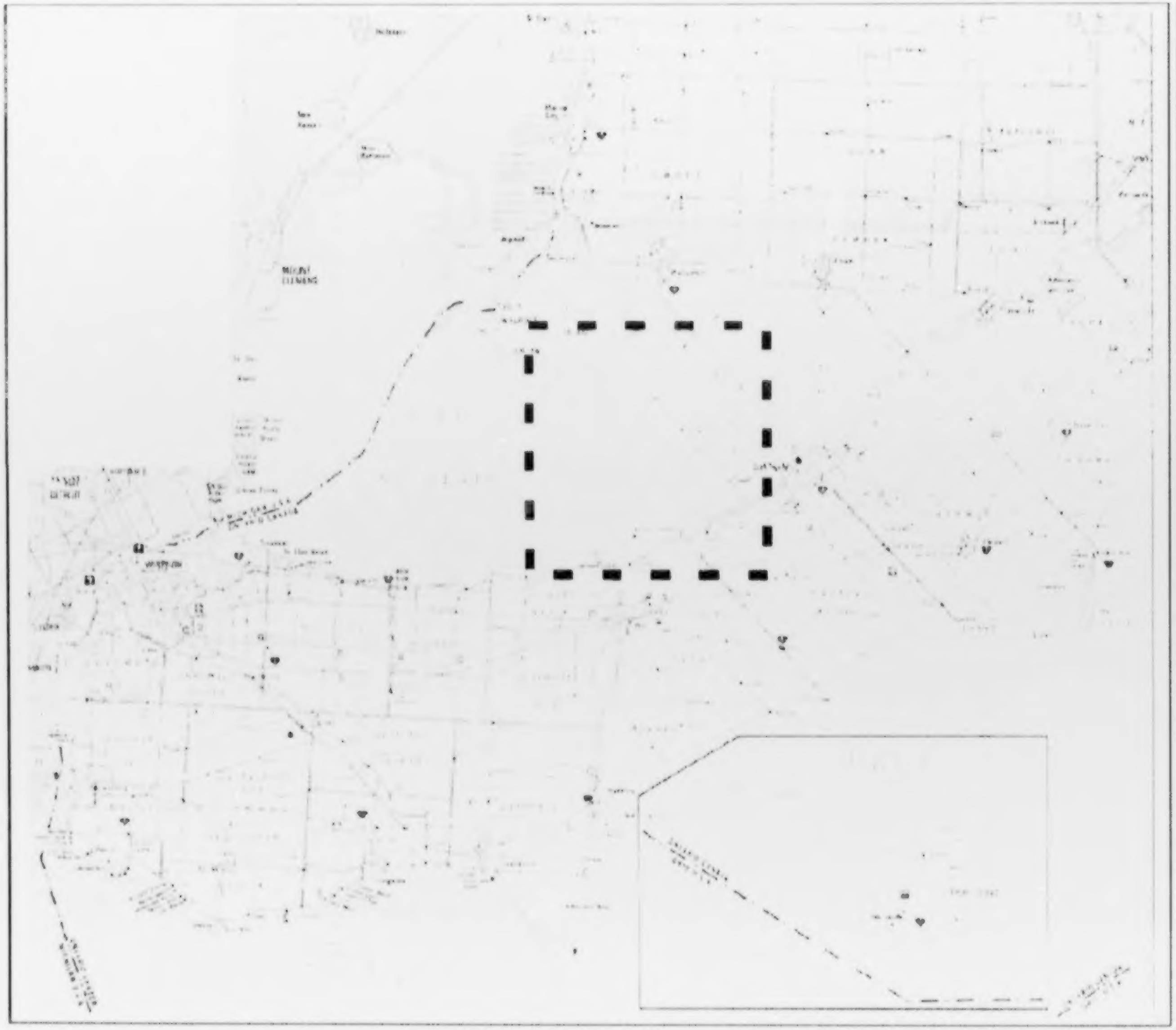

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▭ General Study Area

Project 118900 TT 01

Date Jan 2001

Scale NTS

Drwn/Chkd JPC / SND

Figure 1-1

Study Area - Regional Settings

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types into the project to complement the needs of other migratory and non-migratory species, including vulnerable, threatened and endangered flora and fauna.

A consulting report completed in the summer and fall of 1998 revealed moderate support within the local community for the proposed restoration project (Monteith Zelinaka Priamo Limited, 1998). This support was qualified by general interest from local residents in an assessment of the likely economic, social, and environment effects that might be expected should the project proceed.[2] The following report has been prepared to address local concerns, to evaluate the potential socio-economic and environmental effects of the restoration project, and to serve as a model to assist other EHJV technical committees in undertaking site-specific evaluation of projects proposed under the Implementation Plan.

1.4 Purpose and Objectives

The general purposes of this study are to determine:

- The environmental, economic, and social effects of the restoration project of these 1,000 acres of wetland habitat
- How the benefits identified as part of this study could be applied to similar wetland proposals

The objectives of this study are to identify:

- The economic and social effects that the restoration of a wetland of this size will have on the surrounding area (local and regional), including but not limited to agriculture, tourism, and recreation
- The environmental benefits on local, regional, and continental scales of restoring a wetland in this type of landscape and socio-economic setting

This study has been undertaken as one component of the process to assess the feasibility of implementing the project. If implemented, the final design will undoubtedly differentiate in some ways from the concepts and alternatives presented in this report. Regardless, these alternatives are necessary as a basis to undertake the socio-economic and environmental evaluation.

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[2] A number of other issues and concerns were reviewed during this consultation process and are addressed in Section 8.

1.5 Environmental Assessment Act Requirements

In addition to reviewing the socio-economic and environmental effects of the proposed wetland restoration project, this report also addresses the project's Environmental Assessment Act requirements. These requirements follow the Ministry of Natural Resources Class EA process for small-scale projects. This undertaking is considered a Category "B" project under the Class EA and has been evaluated according to the field environmental planning procedure (FEPP) described in Appendix J. After a preliminary evaluation of the study's results and initial proposed alternatives according to the FEPP, the project may proceed to a more detailed planning level.

1.6 Organization of the Report

Section 2 provides a general overview and description of the study design and research methods (detailed descriptions of specific analytical techniques are located in relevant sections of the report). Section 3 presents a general socio-economic and environmental profile of the study area. Section 4 describes the proposed EHJV project concept. Section 5 presents findings of the comparative analysis of selected restored wetland sites in the Great Lakes Basin. Section 6 addresses potential biological/environmental impacts and values of the proposed restoration project. Section 7 provides estimates of the economic impacts of the proposed restoration project. Section 8 presents an evaluation of alternative design concepts for meeting the project's ecological restoration objectives. Section 9 discusses broader lessons learned. Section 10 presents a summary and conclusions and Section 11 lists references consulted during the preparation of this report. Section 12 acknowledges the contributions of all those who assisted the project team in this study. Supporting material is provided in the report's appendixes.

2. Study Design and Methods

This section provides a general overview of the research design and methods used to address the study objectives; additional details are provided in the relevant sections of the report.

2.1 Lake St. Clair Technical Committee

The EHJV project partners formed an 11-member technical committee to oversee and assist in developing the Lake St. Clair (LSC) restoration project. The committee provides technical supervision and coordination and is overseeing the long-term project management.

2.2 Development of Detailed Work Plan

The first phase in the study design was to refine the study approach and work plan. This process involved four components:

- Identification of a long list of potential wetland values to be considered
- Scoping of specific and appropriate wetland values for more detailed analysis
- Description of valuation methods to be applied to scoped values
- Finalization of the detailed work plan

These components were developed in consultation with, and approved by, the LSC Technical Committee.

Wetland Values

Wetland functions can include water storage, groundwater recharge, water purification, sediment retention, flood protection, and nutrient recycling, along with providing wildlife habitat and maintaining biodiversity.

Wetlands provide myriad ecological, economic, and other functions and benefits to society and natural systems. Wetland functions can include water storage, groundwater recharge, water purification, sediment retention, flood protection, and nutrient recycling, along with providing fish and wildlife habitat and maintaining biodiversity (Young, 1994). Wetlands can also provide significant and unique recreational, sporting, and nature-appreciation opportunities.

Not all values are equally applicable or present in an individual wetland or ecological context. For the LSC study, it was necessary to identify a long list of wetland values that could be realized by the restoration project, and then assess their applicability to the proposed undertaking. These "scoped" values would then form the basis for the site-specific evaluation and assessment.

Table 2.1 provides the long list of wetland values; for classification purposes, these have been grouped into non-consumptive, consumptive,

TABLE 2.1
POTENTIAL WETLAND VALUES

Item	Description	Comments
Non-Consumptive – Ecosystem Values		
Species population protection/ enhancement	Habitat production and/or enhancement. Rare and endangered species, wildfowl populations, other species	Describe impacts in qualitative and/or quantitative terms. The assignment of monetary values is heavily dependent on the quality of existing data/studies. There may be an opportunity to estimate existence and bequest values for the new wetland if suitable information is obtained from literature sources.
Ecosystem protection	Valued systems, linkages, and corridors	See above.
Aquifer recharge	Enhancement of groundwater quality and quantity	Identify opportunities and significance but do not attempt to assign monetary values unless wetland is located in a region where these benefits have potential to contribute measurably.
Discharge to baseflow	Enhancement of surface water quality and quantity	Identify opportunities and significance but do not attempt to assign monetary values unless wetland is located in a region where these benefits have potential to contribute measurably.
Non-Consumptive – Institutional Use Values		
Scientific research	Habitat restoration studies	Identify opportunities and significance but do not attempt to assign monetary values unless wetland is located in a region where these benefits have potential to contribute measurably.
Outdoor education	School trips, summer nature camps	Identify opportunities and significance but do not attempt to assign monetary values unless wetland is located in a region where these benefits have potential to contribute measurably.
Heritage preservation	Recreate historic land forms	Identify opportunities and significance but do not attempt to assign monetary values unless wetland is located in a region where these benefits have potential to contribute measurably.
Non-Consumptive – Recreational/Cultural Use Values		
Nature appreciation	Bird watching, amateur botany, herpetology, etc.	Assess potential opportunities and site capacity for nature appreciation recreation, estimate potential user days and assign values based on literature estimates of user day values, adjust user day values based on site attributes if possible. The analysis should include an assessment of infrastructure investments required to foster this type of use. Consider potential human disturbance impacts.
Other recreation	Hiking, canoeing, skating, picnics, camping, etc.	User-day value approach (see nature appreciation). Opportunities for other types of recreation will depend on site-specific facility objectives and designs. Consider potential human disturbance impacts.
Non-Consumptive – Recreational/Cultural Use Values		
Cultural significance	Historic community attachment/association with wetlands, etc.	Identify opportunities and significance but do not attempt to assign monetary values unless wetland is located in a region where these benefits have potential to contribute measurably. Consider potential human disturbance impacts.
Visual diversity	Landscape perception/analysis	Identify opportunities and significance but do not attempt to assign monetary values unless wetland is located in a region where these benefits have potential to contribute measurably. Consider potential human disturbance impacts.

TABLE 2.1
POTENTIAL WETLAND VALUES

Item	Description	Comments
Consumptive – Recreational/Cultural Use Values		
Waterfowl hunting	Duck and geese hunting	User-day value approach (see nature appreciation). Issues to consider include limitations on the number of hunters, site leasing to hunting parties, competition from/with commercial hunt clubs or other establishments in the vicinity. Consider potential human disturbance impacts.
Other hunting	Rabbits, deer, partridge, grouse, etc.	User-day value approach (see nature appreciation). Opportunities for other types of hunting will depend on site-specific facility objectives and designs. Consider potential human disturbance impacts.
Fishing	Recreational Fishing	User-day value approach (see nature appreciation). Issues to consider include the type of onsite species available for fishing and the enhancement of offsite fishing through the provision of spawning or feeding or prey fish habitat to fish populations in adjoining streams, rivers or Lake littoral zones. Opportunities and potential quality/viability for benefit will depend on site-specific facility objectives and designs. Consider potential human disturbance impacts.
Other non-commercial harvests	Wild foods, plant materials for crafts	User-day value approach (see nature appreciation). Opportunities for other types of recreational harvest will depend on site-specific facility objectives and designs. Consider potential human disturbance impacts.
Commercial Values		
Agricultural sector – benefits	Beneficial impact on production costs or yields associated with water supply during drought episodes	Evaluation based on an analysis of crop insurance records for occurrence and severity of losses due to drought and logical opportunity for the site to contribute.
Agricultural sector – losses	Adverse impact on production costs or yields associated with wildfowl grazing, pest invasions, or disruptions to land drainage	Assessment based on crop budgeting analysis using estimates of yield losses and increases in inputs of labour and materials for crop production. Adverse drainage impacts can be evaluated by assuming a reduction in yields associated with poor drainage.
Tourism sector	Income and employment opportunities created by new recreational expenditures on goods and services	Expenditures estimated based on visitation rates and representative expenditure values. Specific commercial opportunities identified from the assessment of comparable wetland sites and local knowledge/experience.
Commercial harvests	Harvests of bait fish, furs, plant materials, wild foods	Likelihood and opportunity of harvest activities to be assessed on a site-specific basis. Valuation could be based on enterprise budget analysis.
Displacement of enterprises	Loss of onsite farms and other enterprises	Loss to the owner is considered fully offset by virtue of the real estate sale. Estimates of lost income, employment and expenditures to the economy to be used in the multiplier analysis (see below).
Multiplier effects	Income and employment impacts relating to lost enterprises, construction and new commerce	Direct, indirect, and induced employment and income effects can be estimated using input/output analysis or similar approaches or by using known economic-base multipliers.
Flood damage reduction	Reduction in downstream flood damage to crops and buildings based on hydrologic function during floods	A formal analysis of flood damage reduction benefits requires the use of hydraulic modelling, land use inventory and flood stage-damage curves. Given the cost generally associated with these studies, a formal analysis is not recommended unless the area is exposed to flood risk and/or value of potential damage avoided is considerable.
Water and waste-water treatment	Reductions in water and/or wastewater treatment costs associated with water quality impacts	Analysis limited to real savings at existing treatment plants using surface water resources that will experience improvements in water quality can include storage of agricultural runoff. Identify opportunities and significance but do not attempt to assign monetary values unless wetland is located in a region where these benefits have potential to contribute measurably.
Erosion control	Reduction in costs associated with drain maintenance and other erosion mitigation measures	Identify opportunities and significance but do not attempt to assign monetary values in this project unless wetland is located in a region where these benefits have potential to contribute measurably.
Other resource harvesting	Peat mining, rice, wild rice	Identify opportunities and significance but decision/feasibility to assign monetary values will depend on the specific resources harvesting activity.

and commercial values. It is recognized that a number of the values could be interpreted and classed into multiple categories; however, a simple classification is used as a basis of identifying general values. The table also provides comments on general approaches to incorporating this information into an analysis of benefits. While not all of these values are relevant to the LSC project, the long list can be used to provide guidance and a basis of departure for subsequent EHJV evaluations.

Table 2.2 provides the results of the site-specific screening exercise performed on the long list of values. Some values (e.g. groundwater recharge) were screened out simply because they would not be applicable to this wetland given its geographic setting. The design principles and concepts for the restoration project are discussed more fully in Section 4.

Table 2.2 also describes the general approaches to evaluation that were considered or used in the detailed analysis. The specific methods of analysis employed are discussed in the relevant sections of this report.

2.3 Literature Search and Review

A strategic literature search was undertaken at the outset of the project. Keywords used to guide the search are listed in Table 2.3.

The following core databases were queried with the selected combinations of keywords:

- Academic Search Elite
- Water Resources Abstracts
- Environmental Sciences and Pollution Management
- Cambridge Scientific Abstracts
- Duckdata
- Elsevier Journals
- EIS: Digest of Environmental Impact Statements
- Ecology Abstracts
- Applied Science and Technology Abstracts
- Dissertation Abstracts

A general search of Internet resources and publications was also completed using multiple search engines.

TABLE 2.2
VALUATION METHODS FOR LAKE ST. CLAIR WETLAND RESTORATION

Item	Description	Comments / Issues
Non-Consumptive – Ecosystem Values		
Species population protection/enhancement and ecosystem protection	• Identify and describe impact (species and habitats, population impacts)	• Given the scale of the project and available knowledge, it may be difficult to describe clear benefits/impacts over large geographic areas on a waterfowl population basis.
Biodiversity	• Identify and describe species likely to inhabit newly created habitat types. Comparison of before and after conditions (i.e. potential species increase by taxa)	• Design concept scenarios that will include habitat type and size considerations which will influence relative biodiversity impacts (advantages and disadvantages).
Aquifer recharge	• Screened out from detailed analysis/evaluation	• Restored wetland not anticipated to contribute significantly/measurably to affect this value, given its location within the watershed and the presence of the water table close to ground surface.
Discharge to baseflow	• Screened out from detailed analysis/evaluation	• Restored wetland not anticipated to contribute significantly/measurably to affect this value, given its location within the watershed and the presence of the water table close to ground surface.
Non-Consumptive – Institutional Use Values		
Scientific research, outdoor education, and heritage preservation	• Identify and describe opportunities qualitatively	• Not all benefits lend themselves to meaningful quantification and valuation. It is nonetheless critical to identify and describe the benefit so that it can be incorporated into overall project assessment in qualitative form.
Non-Consumptive – Recreational/Cultural Use Values		
Nature appreciation, other non-consumptive uses	• (Average per capita-day use value) * (# of user days)	• Find a meaningful estimate of per capita-day use value for each type of use. • Adjust values to reflect site attributes (ad hoc benefits transfer approach). • Estimate total user days by type: This is a function of total demand, competing and complementary sites, capacity and attributes of new site. If demand is sufficient we can assume full capacity utilisation, but we still have to estimate capacity based on site size, recreation infrastructure (parking, toilets, trails, etc.), and other attributes or by expert opinion.
Cultural significance	• Identify and describe opportunities qualitatively	• Not all benefits lend themselves to meaningful quantification and valuation. It is nonetheless critical to identify and describe the benefit so that it can be incorporated into overall project assessment in qualitative form.
Visual diversity	• Identify and describe opportunities qualitatively	• Not all benefits lend themselves to meaningful quantification and valuation. It is nonetheless critical to identify and describe the benefit so that it can be incorporated into overall project assessment in qualitative form.
Consumptive – Recreational Use Values		
Waterfowl hunting, other hunting, fishing, and other non-commercial harvests	• (Average per capita-day use value) * (# of user days)	• See comments for non-consumptive recreation • Primary focus on waterfowl hunting – develop a reasonable benefits transfer approach for this use. Other uses are likely to be relatively insignificant at this site – use a simple user-day value approach

TABLE 2.2
VALUATION METHODS FOR LAKE ST. CLAIR WETLAND RESTORATION

Item	Description	Comments / Issues
Commercial Values		
Agricultural sector – benefits from irrigation supply	• Screened out from detailed analysis/evaluation	• Volume of available water for irrigation is likely to be small relative to demand during periods of drought
Agricultural sector – losses from waterfowl feeding on crops	• Screened out from analysis based on feedback from local farm operators, marsh managers, and Canadian wildlife serve staff	• If the analysis had been needed, the approach would depend on available data but at a minimum should reflect actual crop systems for the impact area and include: (average % reduction in yield) * (crop yield/ha) * (net crop value) * (ha's exposed to predation) or simplify to (average loss/ha) * (ha's exposed to predation). • Costing should be based on net economic loss with adjustment for reduction in variable costs (e.g. combining, drying costs).
Tourism sector	• Direct impact by type of recreation = ➢ (days recreation) * (expenditure per day within the study area)	• Recreation days should probably be differentiated by origin to distinguish locals from visitors if the data exist. • Local recreational expenditures may represent a redistribution of local spending and not a real increase in local income in the service sector.
Commercial harvests	• Screened out from analysis. Not likely to be a significant use at the site.	• If the analysis had been needed a typical approach would include: New income for each harvest activity ➢ = (harvest amounts) * (sale price) – (harvest costs) ➢ or simplify to (average harvest income) * (# of harvesters)
Construction activity (NEW)	• Identify and describe construction opportunities • Direct income from construction ➢ = (total capital cost) * (% expended within study area)	• Construction costs to be considered in analysis of capital and operating budget. Direct income from construction can also be factored into multiplier analysis.
Displacement of enterprises	• Identify and describe lost enterprises (assume all agricultural) • Assume no net loss of income to the enterprise owner since land sales are on a willing buyer/willing seller basis • Calculate lost income for purposes of the multiplier analysis as: ➢ (ha's taken out of production) * (net income per ha) and/or ➢ (# lost livestock enterprises) * (average income per enterprise)	• Need to assume a profile of cropping systems for the acquisition area(s)
Multiplier effects	• Indirect and induced impacts calculated using a regional I/O model based on direct income effects	• Use simply multiplier approach if a suitable I/O model is not readily available
Flood damage reduction	• Screened out from detailed analysis/evaluation	• Proposed wetland will not be connected to surface water drainage system in a significant capacity to affect this value.
Erosion control	• Screened out from detailed analysis/evaluation	• Proposed wetland will not be connected to surface water drainage system in a significant capacity to affect this value.
Other resource harvesting	• Screened out from detailed analysis/evaluation	• Not anticipate to provide a significant opportunity given the current goals and objectives for the restored habitat.
Water and wastewater treatment	• Screened out from detailed analysis/evaluation	• Proposed wetland will not be connected to surface water drainage system in a significant capacity to affect this value.

TABLE 2.3
LITERATURE SEARCH KEYWORD LIST

General Terms	Valuation, evaluation, benefit assessment, economic evaluation OF Wetlands, resources, natural resources, water resources, recreation
Types of Value Measurements	Willingness to pay, consumer surplus, compensating variation, equivalent variation User-day value, use or user value Non-use value, existence value, option value, bequest value Aesthetics/aesthetics value
Methodologies	Travel cost (model), hedonic travel cost, random utility model Contingent value (or valuation), contingent ranking, discrete choice analysis (or model), conjoint analysis, referendum data, bidding data, benefit transfer Hedonic value, property value model
Activities	Hunting (waterfowl, duck, small game) Fishing (coarse fish, warm water, pan fish, carp, pike, bass) Birding, bird watching Nature viewing, nature appreciation, nature trails Hiking, picnicking Conversion/draining of agriculture land for wildlife habitat Tourism
Programs	Natural resource damage assessment (NRDA)
Environmental/ Biological	Lake St. Clair wetlands, lacustrine marsh ecology Wetland restoration, wetland restoration – impacts, marsh restoration Artificial marshes, artificial wetlands Waterfowl habitat restoration, waterfowl habitat Marsh wildlife, wetland restoration Wetland sediment removal, wetland contaminant removal, wetland wastewater treatment

2.4 Comparative Sites Analysis

A key step in the methodology was a comparative analysis of other restored wetland sites. Given that there are few suitable empirical studies in the literature, in order to assess the potential effects of the project it was essential to collect and interpret data from professionals experienced in restoring and managing similar habitats from comparative sites within the Great Lakes basin.

Seven sites located in Michigan, Ohio, New York, and Ontario were selected for this analysis. The study team, the LSC Technical Committee, and third-party informants were involved in the site identification and selection. Sites were selected based on their potential comparability to the EHJV project and their ability to provide a range of acquisition and management experiences. A summary of the features of these sites is presented in Table 2.4.

TABLE 2.4
COMPARATIVE RESTORED WETLAND SITES

	Total Size	Wetland Area
Hullett Marsh Provincial Wildlife Area, Ontario	5,200 ac. (2,105 ha)	1,680 ac. (680 ha) mostly dyked marsh
Hilliardton Provincial Wildlife Area, Ontario	1,790 ac. (725 ha)	506 ac. (205 ha) dyked marsh, swamp, bog, and fen
Tiny Marsh Provincial Wildlife Area, Ontario	2,300 ac. (930 ha)	1,400 ac. (566 ha) dyked marsh
St. John's Marsh Wildlife Area, Michigan	2,500 ac. (1,012 ha)	1,700 ac. (690 ha) coastal marsh 200 ac. (80 ha) dyked marsh
Ottawa Wetland Complex, Ohio	8,250 ac. (3,340 ha) Total: 5,600 ac. (2,270 ha) Ottawa Refuge: 650 ac.(263 ha) Metzger Marsh 2,000 ac. (810 ha) Magee WA	4,860 ac. (1,970 ha) dyked marsh + 200 ac. (80 ha) natural marsh Ottawa Refuge 620 ac. (250 ha) dyked marsh Metzger Marsh 1,800 ac. (730 ha) dyked marsh Magee WA
Pickeral Creek Wildlife Area, Ohio	3,000 ac. (1,215 ha)	2,000 ac. (810 ha) dyked marsh
Montezuma Wetland Complex, New York	36,000 ac. (14,570 ha) Total: 7,068 ac. (2,860 ha) Montezuma Refuge 7,660 ac. (3,100 ha) N. Montezuma WMA Balance mostly private land	3,600 ac. (1,456 ha) dyked marsh in Montezuma Refuge 5,360 ac. (2,170 ha) dyked marsh in N. Montezuma WMA

Managers at each comparative site were contacted by telephone, and the nature and purpose of the data-collection exercise was explained. A comparative site questionnaire was then faxed or mailed (the list of contacts and the questionnaire are contained in Appendix A). Interviews were conducted by phone; in some cases, completed questionnaires were returned by fax or mail and follow-up phone conversations sought elaboration of some information provided.

For the most part, the analysis is based on the site questionnaires and phone interviews. In several instances, data are drawn from documents provided by managers. The analysis highlights:

- Management objectives for the wetland sites
- Activities, services, and facilities provided
- Waterfowl, other wildlife, and wetland management
- Visitation, promotion, and economic impacts
- Relationships with surrounding landowners
- Staffing and budgets

The detailed analysis of these sites is contained in Section 5.

2.5 Consultation and Communication

Local Advisory Committee

A ten-member Local Advisory Committee (LAC) was formed to assist the LSC Technical Committee. The LAC members represent local residents and businesses, conservation groups, hunt clubs, agriculture, tourism and local services, and municipalities.

For this study, the LAC acted as a discussion forum that assisted the Technical Committee in refining the design of the project. The LAC served as a community link to the EHJV partners, and provided input to the Technical Committee concerning the impact of the proposed project on the local community. The roles and responsibilities of the LAC are described in Table 2.5. The LAC also provided valuable information and feedback to the consultants.

Notice of Study Initiation

To inform the broader community, a Notice of Study Initiation was published in two newspapers serving the study area, on July 24, 1999 in the *Chatham Daily News,* and on July 27, 1999 in *Chatham This Week*. The notice provided key contacts for the study and a toll-free telephone number to facilitate public queries. A copy of the notice is provided in Appendix B.

Newsletters

The EHJV, through the LSC Technical Committee, has published newsletters about the project. Each newsletter was mailed to the contacts on the project distribution list that had been developed during the initial public consultation phase of the project.

TABLE 2.5
MANDATE AND ROLE OF THE LOCAL ADVISORY COMMITTEE

- Provide ongoing advice to the Technical Committee on community support for the project
- Provide comments on consultants' work to the Technical Committee
- Review and provide comments on reports and activities carried out under the Lake St. Clair project to the Technical Committee
- Provide input on the design concept (e.g. what the wetland will look like, permitted uses, how it will be managed)
- Provide input on project site selection criteria
- Provide advice on determination of candidate site location(s) for the project
- Provide input on policies developed for buying and use of farmland to be restored to wetland
- Provide advice on the effects of the wetland on adjacent land uses (e.g. crop compensation issues, etc.)
- Provide input with the promotion of the Lake St. Clair project (e.g. communications, education initiatives, newsletters/bulletins, and information presentations)
- Reflect and disseminate local opinions and local organization support for the project
- Be knowledgeable of the social, economic, and environmental issues/ impacts facing the Municipality of Chatham-Kent
- Act as a liaison to the organizations the LAC represents by relaying information that helps the organizations develop their support for the project
- Reflect their organizations' viewpoints and support at Local Advisory Committee meetings
- Assume a responsibility to ensure the organizations are updated on Local Advisory Committee activities and decisions of the Technical Committee
- Assist the Technical Committee with the facilitation of community meetings regarding the project

Local Key Informant Interviews

Interviews were held with a number of key informants on August 25–26 and September 14–15, 1999; key informants included operators of local hunt clubs, outfitters, and farm operators. Information was collected from these individuals on the understanding that it would remain confidential and would be used only in aggregate, to assist primarily in the economic analysis. A copy of the interview guide used is provided in Appendix C.

2.6 Technical Workshop on Biological and Biodiversity Effects

A technical workshop was held on November 15, 1999 to explore the scientific foundations for the biological and biodiversity assessment components of the study. The purpose of this workshop was to identify and address anticipated effects of wetland restoration on waterfowl, specifically, and biodiversity, generally. It was recognized that there is a range of data sources, availability, and accuracy. Therefore, the workshop was convened to bring a number of technical experts together to share information and research results and to get a consensus on the best science to be used in approaching the biological evaluation of the proposed project.

Twenty-two people participated in the workshop, including representatives from Environment Canada; Ontario Ministry of Natural Resources; Ontario Ministry of Agriculture, Food & Rural Affairs; Ducks Unlimited; the LSC Local Advisory Committee; and the consulting team. A list of workshop participants is provided in Appendix D.

3. Description of the Study Area

This section provides a general overview and profile of the location and key physical, biological, and socio-economic features of the study area; additional supporting information is found in Appendix E.

3.1 Location

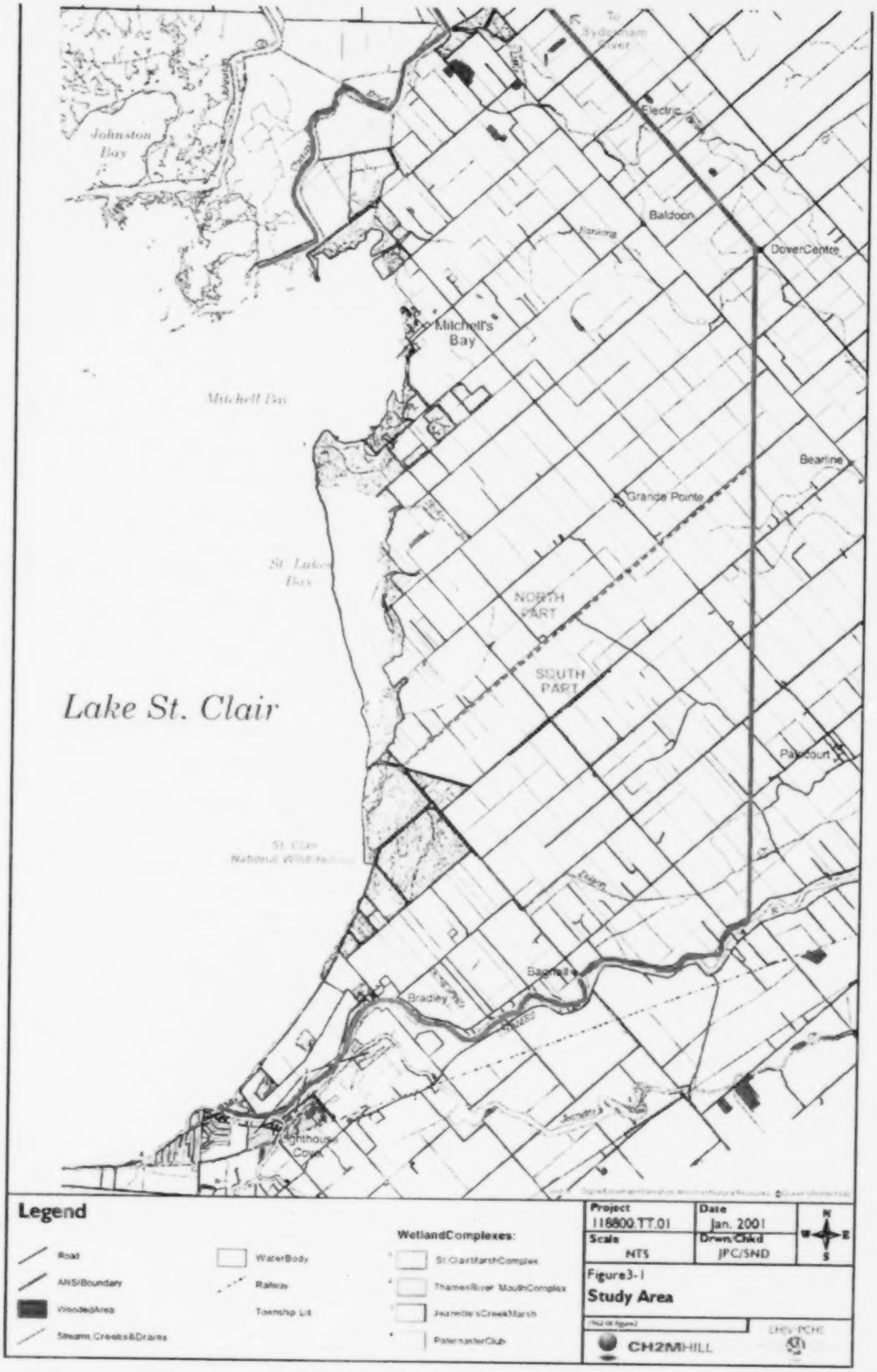
The general study area is shown in Figure 3-1. It is located along the eastern shoreline of Lake St. Clair and includes the majority of the former Dover Township in what is now the Municipality of Chatham-Kent. It generally encompasses the shore areas and the land area approximately 8 km inland from Lake St. Clair and is bordered by the Thames River to the south and the Sydenham River to the north. Communities within the study area include the Town of Mitchell's Bay and the Villages of Bagnall, Baldoon, Bearline, Bradley, Dover Centre, Electric, and Grande Point.

The Lake St. Clair shoreline is approximately 272 km. The shore of the St. Clair River and its main distributary channels combined with the Detroit River and Belle Isle add 224 km. Of this total 496 km of shoreline, 188 km (38 percent) can be classified as coastal wetland (Herdendorf and Raphael, 1986). The wetland complex along the eastern shore of the lake, illustrated in Figure 3-1, consists of 21 individual marshes. Most of these remaining wetlands are dyked and have been maintained to provide waterfowl hunting opportunities.

Lake St. Clair is a very shallow lake, with a zone no more than 1 m deep extending 0.5 to 1 km into the lake. Because of the extent of this shallow area, wetland zones are constantly changing in size and composition depending on lake levels and climate factors. Lake St. Clair has a mean depth of only 3 m, and a maximum natural depth of 6.4 m. Its deepest waters are found along the dredged channel between the St. Clair and Detroit Rivers, which is 8.2 m below low water datum (Herdendorf and Raphael, 1986).

3.2 Physical Features

The study area is located in the St. Clair Clay Plain physiographic region, which encompasses the majority of the counties of Lambton, Kent, and Essex (Chapman and Putnam, 1984). Figure 3-2 illustrates three variables in major soil type: clay plain, sand plain, and an area of peat and muck near the northern limits of the study area, all of which are underlain by black shale.


To Sydenham River
Johnston Bay
Electric
Baldoon
DoverCentre
Mitchell's Bay
Mitchell Bay
Bearline
Grande Pointe
St. Lukes Bay
NORTH PART
SOUTH PART
Lake St. Clair
Paincourt
St. Clair National Wildlife Area
Bagnall
Bradley
Thames
Lighthouse Cove
Legend
Road
ANSIBoundary
WoodedArea
Streams,Creeks&Drains
WaterBody
Railway
Township Lit
WetlandComplexes:
St.ClairMarshComplex
ThamesRiver MouthComplex
Jeanette'sCreekMarsh
PaternosterClub
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Date Jan. 2001
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Figure3-1

Study Area

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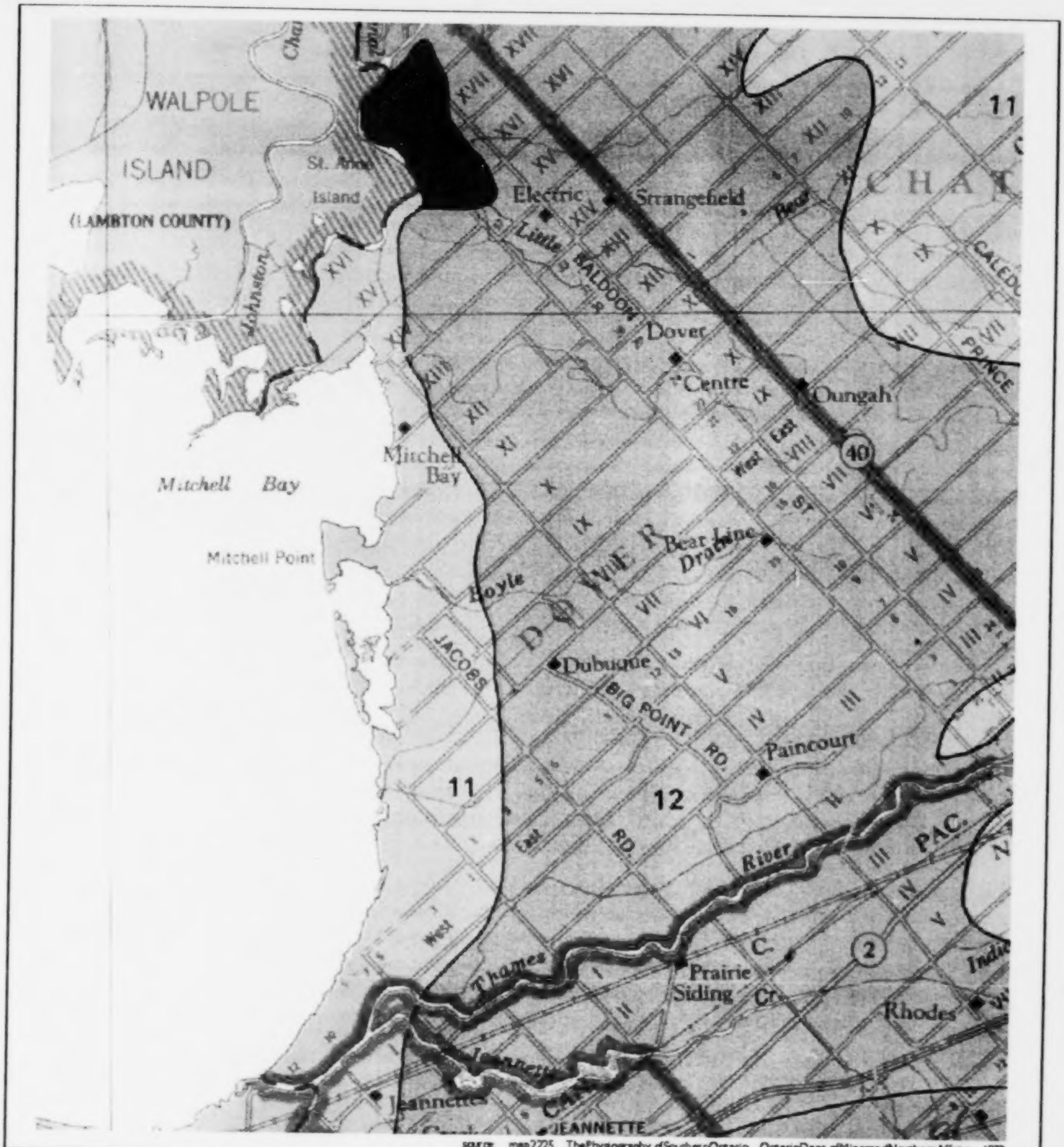
WALPOLE
ISLAND
(LAMBTON COUNTY)
St. Anne
Island
Johnston
Electric
Strangefield
Little
BALDOON
Dover
Centre
Oungah
40
CHAT
CALEDO
PRINCE
Mitchell Bay
Mitchell Bay
Mitchell Point
Boyle
DOVER
Bear Line
Drain
JACOBS
Dubuque
BIG POINT RD.
Paincourt
11
12
11
River
Thames
PAC.
Prairie Siding
C.
Cr.
2
Rhodes
Jeannettes
JEANNETTE
East
West
RD.
ST.

source: map2225 The Physiography of Southern Ontario Ontario Dept of Mines and Northern Affairs 1972

Legend

☐ Clay Plain

▨ Sand Plain

■ Peat and Muck

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Figure 3-2

Physiographic Regions

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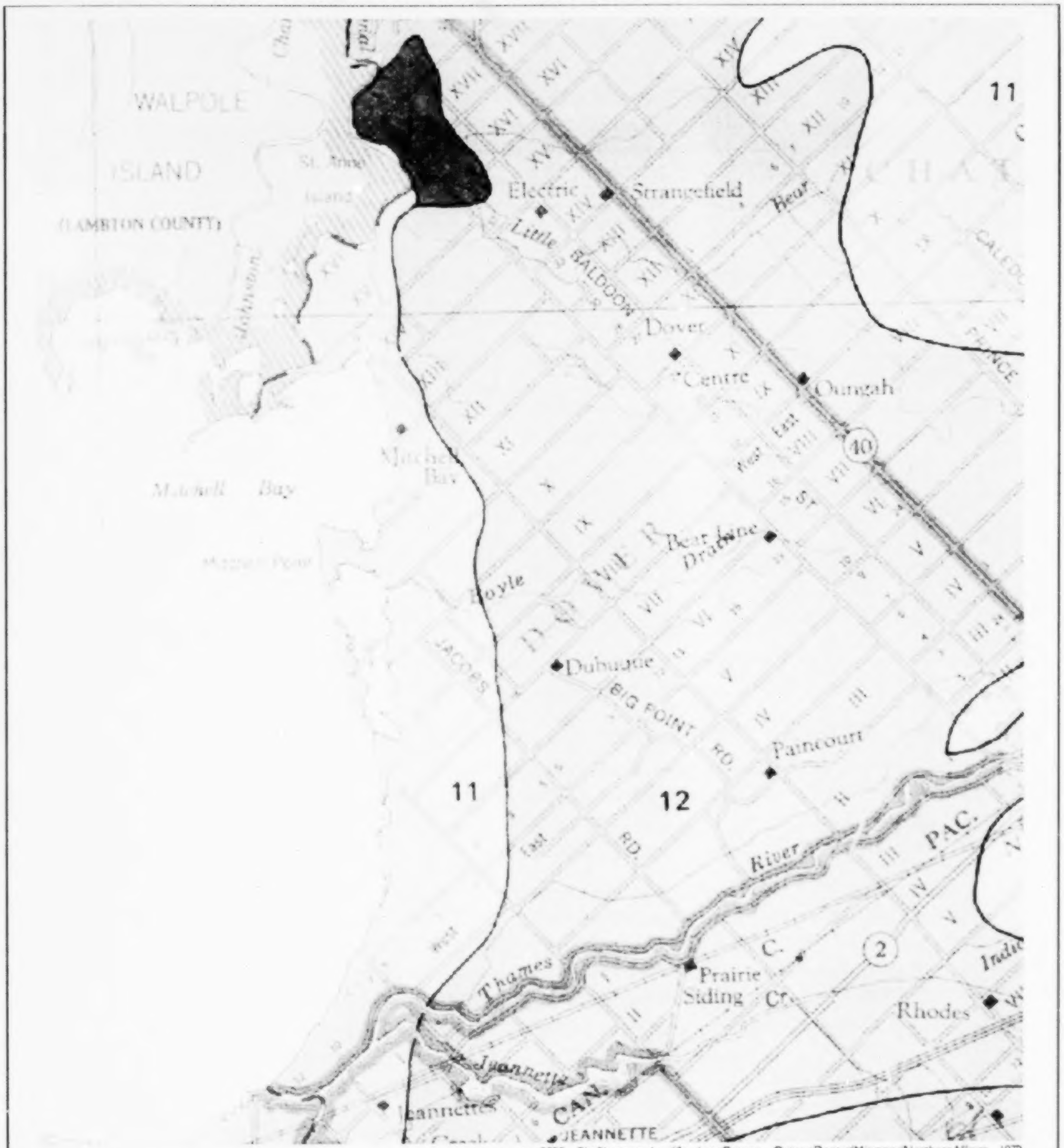

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source map2225 ThePhysiography ofSouthernOntario OntarioDept ofMinesandNorthernAffairs 1972

Legend

☐ Clay Plain

☐ Sand Plain

■ Peat and Muck

Project 118800 TT 01	**Date** Jan 2001
Scale NTS	**Drwn/Chkd** JPC / SND

Figure 3-2

Physiographic Regions

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The St. Clair Clay Plain has little relief, with the area draining east to west toward Lake St. Clair. Historically, the area supported a forested swamp consisting of elm, black and white ash, and silver or red maple; along the shoreline of Lake St. Clair, the predominant vegetation was meadow and marsh (see Figure 6-1). There was little development in the area until the municipalities established artificial drainage, initially by gravity drains. Beginning in the 1880s, portions of wetland in the Dover Community were dyked and drained by pumps (Lauriston, 1952). Over time, an extensive system of dykes, drains, and pumping stations developed, protecting about 40,000 acres of land at or below the level of Lake St. Clair (Roy, 1986). As a result of this development, many of the historic wetland features in the area have been dyked and drained to support agriculture, resulting in the loss of 90 percent of the areas non-coastal wetlands.

High water levels and storms on Lake St. Clair during the early 1970s weakened dykes along the lake, and portions of the drained farmland were flooded in 1973. The provincial government initially provided funds for emergency dyke repairs, and in 1974 Canada and Ontario signed an agreement under the Agricultural and Rural Development Act (ARDA) to rebuild dykes along the Lake St. Clair shoreline, the lower Thames River, and several other watercourses in Kent County. The major part of this project involved the Lake St. Clair shoreline, where 35 km of dyke reconstruction and realignment were completed in 1978 (Roy, 1986).

The St. Clair Clay Plain is subdivided into four regions: the Essex Clay Plain, the Lambton Clay Plain, the Chatham Flats, and the St. Clair Delta. The study area includes a large portion of the Chatham Flats and a smaller portion of the St. Clair Delta in its northern reaches. The Chatham Flats is a small region of highly fertile soils, created during the last glacial period; the resulting Clyde Loam soils are stone-free and high in mineral and organic content. These factors, combined with 155 to 165 frost-free days annually, have influenced agricultural development in the area, with the high-value farms being given to the production of cash crops, some vegetables, and few livestock. There is no significant erosion on the clay plains, although the area is prone to summer droughts. The St. Clair Delta consists mainly of open-water marshes and a thin beach area, although several thousand acres have been drained and currently support agricultural operations. This delta is an excellent example of a bird's foot delta, with the only settlement being within the boundaries of the Walpole Island First Nation.

3.3 Biological Features

The St. Clair Delta is the largest fresh water delta in the world.

The St. Clair Delta is the largest fresh water delta in the world. At one time the entire lake was almost completely vegetated with submergent vegetation; extensive wild celery beds, important for diving ducks, characterized much of the lake bottom (Koonce, Minns and Morrison, 1999). Most of these beds, along with other species of wetland flora and fauna, have been degraded or eliminated by human land use including residential shoreline development.

The Lake St. Clair wetlands are principally recognized for their importance to waterfowl (EHJV, 1994; Roy, 1986). The Canadian Wildlife Service considers the site to be of national significance as a waterfowl staging area. A survey completed in 1984 by the Canadian Wildlife Service showed the east marshes of Lake St. Clair to be second only to the Long Point Marshes among the 17 staging areas throughout the Southern Great Lakes for the quantity of waterfowl days. The marshes also rank second among the 17 staging areas for the intensity of waterfowl use in autumn, and fourth in spring.

The St. Clair National Wildlife Area, a 600-acre portion of the Lake St. Clair Marsh Complex, is designated a Wetland of International Importance under the Ramsar Convention and is also part of a Provincially Significant Life Science ANSI. It is considered one of the most important staging areas for waterfowl in Ontario because of its location at the intersection of the Atlantic and Mississippi flyways, which are major migratory routes for many species of birds.

A large number of bird species depend on the marshes for feeding and resting areas during their migration. Because of their southerly location, the Lake St. Clair wetlands are generally among the last in Canada to freeze in the fall and the first to open in the spring. The open marshes and submergent vegetation attract a variety of diving ducks, while the dyked marshes adjacent to agricultural fields attract dabbling ducks, geese, and swans.

Heron tracks in snow

Muskrat are found throughout the marshes. Historically, the muskrat has held a strong local cultural and social significance. For example, in the early 1980s trappers in Chatham-Kent, Essex, and Lambton counties harvested approximately 110,000 muskrat, mainly from the Dover Community and Walpole Island. Although no longer widely exploited for commercial purposes, the muskrat does play an important role in the wetlands by preventing cattails from completely dominating marsh areas and preserving the vegetation diversity. The muskrat is considered a nuisance by some, as the animals will often dig into and damage marsh dykes. Trapping and removal of muskrats along dykes is an essential component for the maintenance of dyked marshes.

For the most part, Lake St. Clair and the tributaries that drain into it are warm-water fisheries. The undyked marshes along the lakeshore are designated as regionally significant for their fish spawning and nursery habitat, upon which many of the species occurring in the lake are dependent. The lake supports a healthy sport fishery: yellow perch, walleye, large and smallmouth bass, and northern pike are popular species with anglers. The tributaries mainly support populations of coarse fish such as carp and sucker.

3.4 Socio-Economic Features

General Land Use

The municipality of Chatham-Kent, established on January 1, 1998, combines the former City of Chatham with the former Kent County municipalities, including the former Dover Township.

Figure 3-3 presents the generalized land-use designation in the region as presented in the former township's Official Plan.[3] Agricultural land in the Dover Community is some of the most productive in Ontario, and is the economic base for the community.

Hamlet areas in the region include Dover Centre, Grande Point, and Mitchell's Bay. These areas provide low-density residential housing and local services to the surrounding agricultural areas.

The following socio-economic area profile provides useful information to assist in the assessment of potential impacts; detailed support tables are located in Appendix E.

The majority of the data is derived from the 1996 census.

Population

The population of the Dover Community was approximately 4,000 in 1996, distributed among age groups as follows:

- 0-4 years, 6.8%
- 5-14 years, 14.6%
- 15-19 years, 7.9%
- 20-24 years, 6.2%
- 25-54 years, 43.3%
- 55-64 years, 10.0%
- 65-74 years, 7.3%
- 75+ years, 3.8%

Overall, there are slightly more males than females within the population: 2,075 and 1,965, respectively. Almost half the population is between ages 25 and 54, with a mean age of 35.

Language

The primary first language of residents in the Dover Community is English, at 72.0 percent, compared to 72.8 percent provincially. French represents the next most common first language, at 15.3 percent, compared to 4.1 percent provincially. All other first languages represent 7.8 percent of the population, compared to 0.7 percent provincially. The Dover Community has a population of French and other-language residents that is slightly higher than the provincial average.

Education

The level of schooling achieved by residents 15 years of age and over is as follows: 38.2 percent have not completed high school; 17.3 percent

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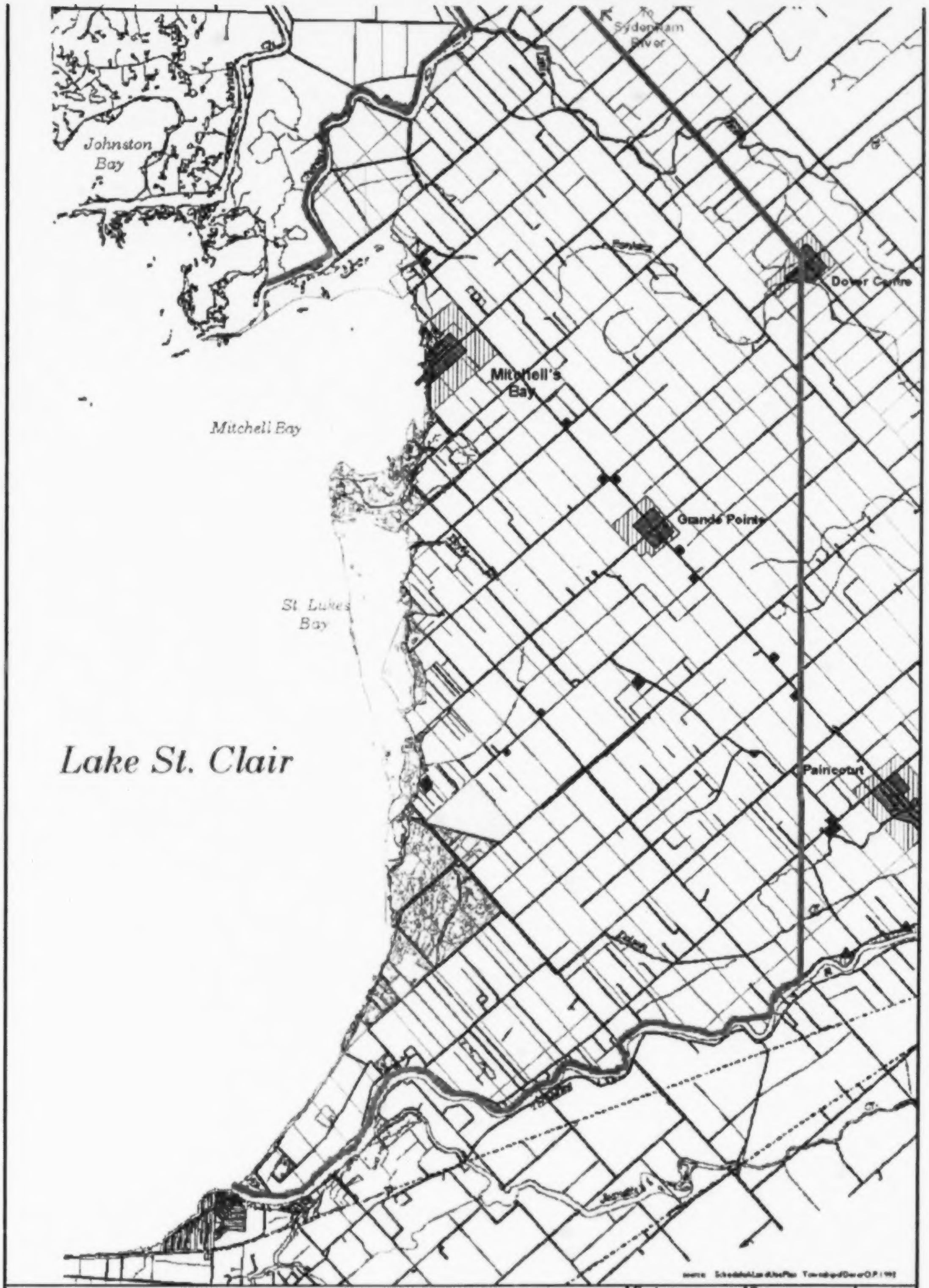
[3] Township of Dover Official Plan (Official Consolidation), 1992 (as modified).


To Sydenham River
Johnston Bay
Dover Centre
Mitchell's Bay
Mitchell Bay
Grande Pointe
St Lukes Bay
Lake St. Clair
Paincourt
Legend
Roads
Railway
LandUseAreas:
HamletArea
RestrictedAgriculture
IndustrialCommercial
Marshlands
EstateResidential
WasteDisposalSites/TransferStations (ActiveorFormer)
Agriculture
N
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S

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Figure3-3

General LandUse

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have achieved a high school certificate; 9.0 percent have some post-secondary education; 27.2 percent have trades or non-university certificates or diplomas; 8.2 percent have completed university.

Income and Work

Labour-force statistics provide an indication of the number of people employed in a particular sector of the economy. Labour-force numbers include people who are unemployed but actively looking for work in their respective sector. The following discussion provides labour-force statistics for the Dover Community as described in the 1996 census.

The average total income in the Dover Community is $28,370, which is 3.7 percent higher than the provincial average of $27,309. The average unemployment rate within the Dover Community is 6.0 percent, which is lower than the provincial average of 9.1 percent.

The participation rate is defined as the ratio of the total labour force and the size of the population that is eligible to work (i.e. ages 15–65). The participation rate for the Dover Community is 80.4 percent for males and 65.4 percent for females; the total average of 73.1 percent is higher than the provincial total average of 66.3 percent.

Primary industry (agriculture and resource-based) employs 20 percent of Dover Community residents, compared to only 3.0 percent of the provincial population. Secondary industry (manufacturing and construction) employs 22.8 percent of the community labour force, compared to 22.5 percent provincially. The remaining 54.5 percent are employed in tertiary industry (service).

The Farm Sector

Agriculture is the dominant land use and a significant means of livelihood and cultural heritage within the study area. Table 3.1 provides a summary overview of the farming sectors; detailed statistics are found in Appendix E.

Overall, agriculture in the study area is dominated by cash crop operations producing mainly grains and oilseeds. Few vegetable and very few livestock operations exist in the study area; the fertile soils, flat landscape, and extended growing season are most conducive to cash crop production. A decrease in the number of farms and an increase in gross total receipts and the number of acres being irrigated may be indicative of larger operations buying smaller farms and the associated farmland. A decrease in the variety of crops being grown but a stable number of acres being farmed also supports this theory. Current economic conditions support an increase in vegetable production, most notably tomatoes.

TABLE 3.1
AGRICULTURE: SUMMARY OVERVIEW FOR 1996*

Characteristics	Dover Community
Total Number of Farms Reporting	331
Livestock and Poultry Farms Reporting	4
Grain and Oilseed Farms Reporting	265
	Acres
Total Area in Agriculture	73,676
Total Area Owned	42,729
Total Area Rented or Leased	30,947
Area Land in Crops (excluding xmas trees)	67,522
Area Irrigated	1,359
Corn for Grain	27,718
Soybeans	27,112
Total Area for Wheat	5,902
Total Area Vegetables	6,064
Tomatoes	3,475
Green Peas	1,339
Carrots	641
Cucumbers and Gherkins	53
Peppers	97
Other	9

* Source: 1996 Census of Agriculture

Land Tenure

The use of rental land is a major contribution to the agricultural production practices in the region. Between 1991 and 1996 there was a 13 percent increase in the amount of rented agricultural land in the Dover Community, which is likely a result of increased vegetable production.

Area of Land in Crops

From 1991 to 1996 there was no significant change in the land area in crops. There was a noticeable increase in the number of acres being irrigated, from 726 acres in 1991 to 1,359 acres in 1996; this represents an increase of 87.2 percent.

Gross Farm Receipts

From 1991 to 1996 there was a 2.4-percent decrease in the total number of farms in the Dover Community (from 339 to 331). During the same period there was an increase in sole-proprietorship farms and in the number of farms reporting gross total receipts in excess of $250,000.

Hunting

The Lake St. Clair marshes were hunted by early European settlers and Native North Americans who depended on the abundance of water birds. In the 1800s, commercial market hunting was an important economic activity within the St. Clair basin. Recreational waterfowl hunting is currently prevalent throughout the area and is an important part of the local cultural heritage. Hunting is conducted on private land and public Crown-owned areas.

The majority of the remnant marshes within the study area owe their existence to their importance as hunt clubs. These privately owned hunt clubs are typically lightly hunted by the landowners, their families and guests. Many of these clubs employ marsh managers as property caretakers and hunting guides. Adjacent privately owned agricultural fields are also hunted, by the landowners themselves or, commonly, leased for profit.

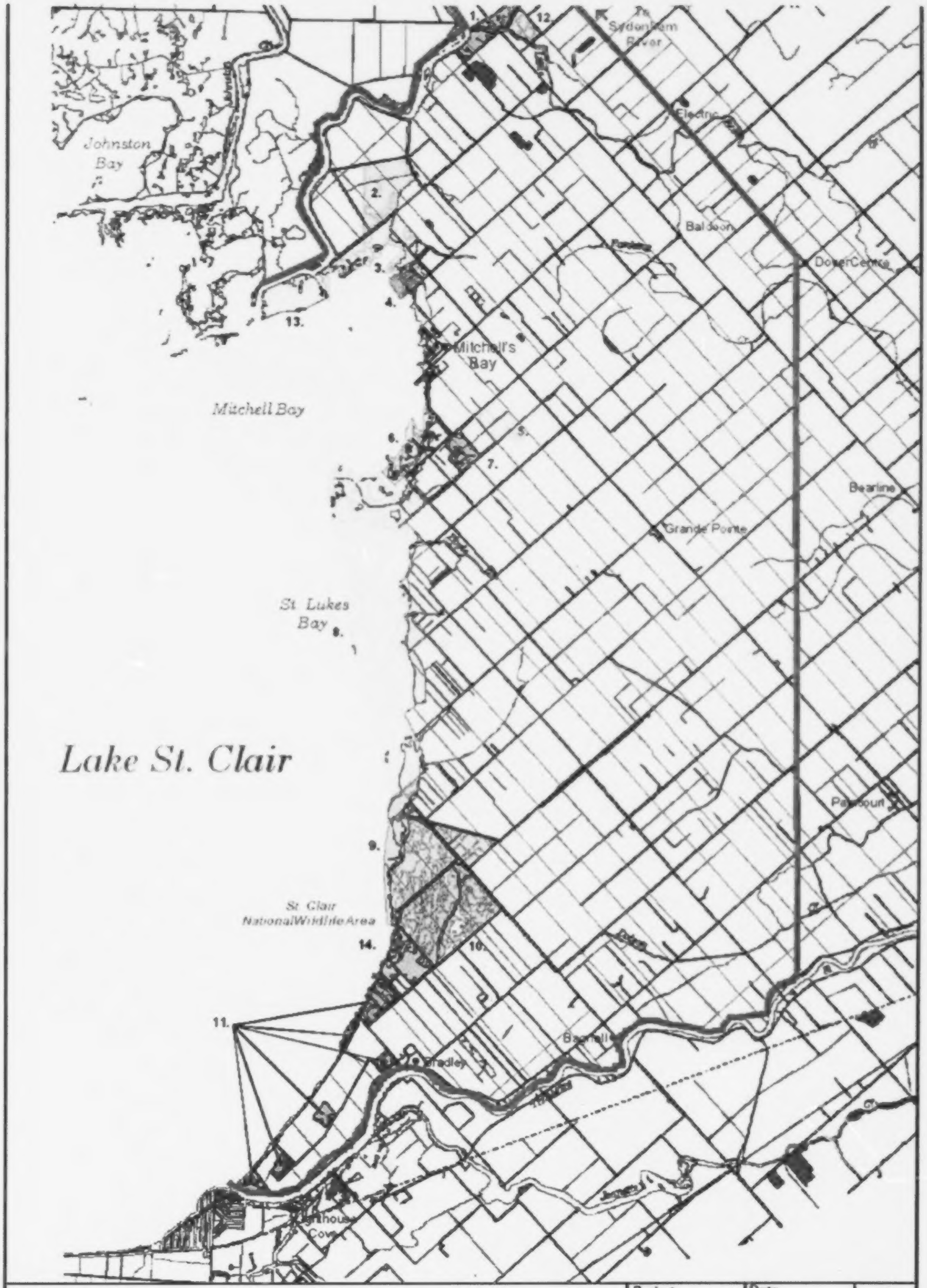
Waterfowl hunting is a significant element of the local community's heritage and culture.

Limited public waterfowl hunting opportunities exist along the Crown-owned lakeshore within 300 m of the vegetated shore or private property lines.

Numerous commercial hunting businesses operate in the area, offering a variety of hunting packages to a mainly American clientele. These commercial hunting operations range from modest daily hunting blind rentals to elaborate packages including accommodation, exclusive access to leased or privately owned properties, hunt guides, dogs, meals, and game cleaning. The locations of hunted marshes and clubs are shown in Figure 3-4.

Other Outdoor Recreation

Lake St. Clair is a popular and significant recreation destination throughout the year and provides recreation opportunities for nature appreciation, fishing, boating, and other water sports. These activities support a number of local marinas, outfitters and suppliers, and restaurants in the area. As noted above, public access to the lake is extremely limited in the study area. Increased access to public recreation opportunities provided by the restoration project would be beneficial to the local community.



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To Sydenham River
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Dover Centre
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Mitchell's Bay
Mitchell Bay
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Bearline
Grande Pointe
St Lukes Bay
8.
Lake St. Clair
Pain Court
9.
St Clair National Wildlife Area
14.
10.
11.
Bradley
Lighthouse Cove
Legend
Road
AHSI Boundary
Wooded Area
Streams, Creeks & Drains
Water Body
Railway
Township Lot
1. Bear Creek Unit St. Clair NWA
2. Mud Creek Club Marsh
3. Petal Marsh
4. Rex/Cadotte Marsh
5. Waterline Marsh
6. Bay Lodge
7. Rex Club Marsh
8. Big Point Club
9. St. Luke's Club
10. St. Claire National Wildlife Area
11. Bradley Farm Marsh
12. Pigeon Marsh
13. Redhead Marsh
14. Balmoral Marsh
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Figure 3-4
Eastern Lake St. Clair Hunt Clubs and Marsh Properties

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4. General Design Concepts

This section presents a conceptual overview of the design and management concepts for the proposed wetland restoration project. These concepts are based on fundamental principles developed largely by the Lake St. Clair Technical Committee with explicit input and refinement from the Local Advisory Committee (LAC). The concepts presented are not the proposed final or preferred conditions. They do, however, form the "base case" for the economic and biological effects assessment.

4.1 Concept Overview

The primary purpose of the project is to restore 1,000 acres of wetland habitat for staging waterfowl. The secondary purpose is to provide other environmental benefits and to generate social and economic benefits where possible. These benefits are expected to occur over a variety of spatial and temporal scales.

The restored habitat will likely consist of three to six wetland cells separated by dykes. Water levels within each cell will be controllable, thereby enabling independent management of each cell. The project will be designed and implemented to ensure that the existing Agricultural and Rural Development Act (ARDA) dyke and local drainage network and infrastructure will not be negatively affected.

Basic Cell Design

In keeping with the intent to create staging habitats, all cells will likely consist of a mix of emergent marsh and open-water habitats. These cells would provide both resting and feeding habitat for waterfowl and other wetland-dependant species.

Constructed wetland cell

To facilitate the wetland restoration, all cells will be dyked. The dykes are expected to be typical and they will be only as wide as needed to ensure structural integrity and to meet access requirements. These dykes would be vegetated and provide only limited upland habitat values.

Depending upon the topography of the acquired lands, there may be sections of land of various shapes within a cell that do not lend themselves to wetland restoration. These areas will most likely be maintained as upland habitat. Depending upon their size and other factors, they could be managed to create some of the special habitats identified below, or they could be left to naturalize on their own.

Incorporation of Optional Habitat Types

The design and management of the wetland will focus primarily on maximizing benefits to migrating waterfowl. However, the incorporation of ancillary compatible habitats has the potential to greatly increase the biodiversity and socio-economic benefits of the project; therefore, consideration is being given in the final design to the compatible needs of other migratory and non-migratory species, including vulnerable, threatened and endangered plants and animals. Habitat types that have notionally been included in the general design concepts for detailed evaluation include mud flats (approximately 50 acres), tall grass prairie (approximately 20–100 acres), and swamp (approximately 20 acres).

Access and Related Facilities

Public access to the site is important to both the Eastern Habitat Joint Venture (EHJV) partners and local citizens. Potential benefits from incorporating public access into the design include revenue from user fees and economic benefits to local and regional businesses. A small office facility would be included as part of the base case scenario for the project.

Ideally, all access to the site will be controlled through a single entry point. Most or all cells will be accessible by a trail network, although seasonal restrictions will likely apply depending on the cell type. Viewing towers will likely be constructed. Parking facilities will be constructed. Launch facilities for small (non-motorized) boats may be provided in some cells. Interpretive facilities could be incorporated into the project design.

4.2 Expected/Optional Uses

The restored wetland could provide opportunities for a variety of recreational, educational, and commercial uses by local residents, tourists, and others. It is also important that the use of the wetland generate revenues that can be used to support its ongoing maintenance and management. It will also be necessary to control public access in ways that will optimize people's enjoyment but not interfere with the purpose and value of the area as prime habitat; public use may be restricted in certain areas and during certain times of the year. Table 4.1 describes the list of likely uses for the restored wetland. This list was developed in close cooperation and detailed consultation with the LAC. Table 4.2 identifies expected uses and potential scheduling conflicts.

TABLE 4.1
PROPOSED USES/ACTIVITIES ST. CLAIR WETLAND PROJECT

Activity	Potential Capacity			Commercial Value		Use Intensity		Access	Potential Problems
	High	Low	Variable	Yes	No	High	Low		
Nature Appreciation (general birding, hikers, photography, etc.)	Habitat potential for shorebirds and related wildlife/ waterfowl Greater habitat diversity will increase appreciation opportunities			For offsite community, guiding/tour opportunities Need blinds to prevent flushing of all birds on the cell		Approx. 2,000 to 10,000 user days for shorebird viewing, depending on habitat unit and facilities General viewing nature clubs, etc.		Birders, specialized group use Level of use high if Rare/Threatened and Endangered Species (RTEs) present Control use if RTEs present Control use by: day/cell/ activity	May need to accommodate buses Site degradation with high level of use Too much traffic potential to disturb staging Potential user conflicts (e.g. hunters – birders)
Research			Proactive via networks Not impinge on wetland integrity and use (non-obtrusive)	Possibilities for commercial rice production			Spot to station research trailer Monitoring wildlife (fee to see it done (tour))		Facilities not extensive
Education 3 levels/types: - Self guided - Tours - Packaged programs	✓			Fee for access		Short-term use tours Host open houses, special events School programs (May, June) Targeted but not exclusive			Need facilities (e.g. signage, kiosk) Need to control access to avoid over use of site
Trapping Muskrat control			1 to 4 trappers, dependent on muskrat population Trapping Intensity: - Winter: 30 days - Spring: 2 weeks	✓			As needed	As needed; recreational mostly Winter/Spring	Benefit depends on prices and number of muskrat Pop'n muskrat: 5 muskrat/acre May need to pay trapper for the service

TABLE 4.1
PROPOSED USES/ACTIVITIES ST. CLAIR WETLAND PROJECT

Activity		Potential Capacity		Commercial Value		Use Intensity		Access	Potential Problems
	High	Low	Variable	Yes	No	High	Low		
Fishing Several up to 100 days		Casual, low quality Species: Blue gill, crappie, and bass			✓		Not a priority use Management Implication costs	Degree of control Not allowed during staging and other times of the year No power boats	Winter kill Limited potential for development unless actively stocked and managed
Boating Not a primary activity Photography and viewing opportunities		✓		Canoe/punt boat tours/ rental Minor economic benefit for community			No motors but canoes and small boats allowed	Restricted to avoid staging disruptions Open August, early spring	Certain cells only Configuration dependent Liability issues
Camping Size: 1 to 2 ac. Site		Private/public? Target youth/ other groups		Potential fee	Some facilities required		Day use Day camps, scouts, and other groups Social/education benefit associated with special events	Closed after 9:00 p.m. Day access seasonal use	Control/insurance issues Standard waiver forms to compile by user groups to control access User group liability ensures covered
Skiing			Cross-country skiing Dependent on snow depth		Not likely due to quality of facilities		No groomed trails Occasional use by locals	No wheeled vehicles, ATVs, or snowmobiles	Surfacing on dykes governs activity types (i.e. grass vs. harder surfacing) Liability ice unpredictable which could restrict this use
Hunting General Fee Access			Depending on cell size/configuration Limited number of blinds but very high demand	Charge what the market will bear +$50 fee (per person, per half-day, per blind – 2 people per blind)		3 morning and evening hunts 500 hunter days/year		Designated Apprentice days? Designated times (i.e. 3 morning and evenings)	Competition with other marshes Efficiency/shell limits Priced to local competitors' prices Allocation for local residents

TABLE 4.1
PROPOSED USES/ACTIVITIES ST. CLAIR WETLAND PROJECT

Activity		Potential Capacity		Commercial Value		Use Intensity		Access	Potential Problems
	High	Low	Variable	Yes	No	High	Low		
Hunting High Fee Access			Unlikely unless something "above and beyond" general access blinds is available	✓			Guided hunts only in one or some cells? 500 ac. (202 ha)	Restricted if at all	Hard to charge more $ for same opportunity
Bait Fish Harvest		✓		Possible to allow commercial harvest tc offset operating costs if bait fish are present in sufficient numbers			✓	Limited access No boats No access if bait fish number low	
Bird Dog Trial and Training	✓			Charge organization and portion of participants' fee goes to marsh			One weekend per year	Must be careful to control numbers to limit disturbance 60-75 ac.	Organizers will want the best piece of land/marsh to run this. Must be carefully regulated
Birding Festivals	✓			Charge a fee for parking and access			One or two weekends per year		
Bird Sanctuary			Set some areas off limits at all times Set some areas off limits according to need (i.e. nesting sites)		No		Research?		
Mineral Extraction			Check mineral rights during land acquisition phase	Possible revenue to help defer cost of operations			✓		Environmental, and aesthetic impacts must be zero
Fundraising Dinners			Limited numbers of attendees and functions	Funds to be used as operating capital					

TABLE 4.2
USES AND SCHEDULING

Use/month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Nature Appreciation			■	■	■		■	■	■	■	■	■
Bird Festivals			▨	▨	▨			▨	▨	▨	▨	
Trialing and Training				▨	▨	▨	▨	▨				
Research	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Education	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Trapping	■		■ ■									
Fishing			▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Boating					▨	▨	▨	▨				
Camping					▨	▨	▨	▨				
Hunting									■	■	■	■
Skiing	▨	▨										

Black squares indicate more or less continuous activity.
Grey squares indicate ongoing activities, which may create conflicts.

4.3 Adjacent Land Use

An issue that must be addressed is the possibility that the placement of the wetland on the landscape could lead to new restrictions on development (over and above those that already exist) on lands that immediately surround the facility.

The wetland is expected to meet the requirements of provincial significance within a few years of construction. As such, the provisions of the wetland component of the Natural Heritage Policy of the Provincial Policy Statement would normally be expected to apply to new development proposals requiring Planning Act approvals, provided that such proposals fell within the adjacent lands as defined by the policy.

Recognizing that this project involves the creation of wetland rather than the protection of an existing wetland, and recognizing that public support is critical if the project is to proceed, the MNR, as the agency responsible for this policy, has indicated willingness to support reasonable flexibility in the application of the policy. Specifically, the MNR is willing to work with the municipality (in a manner consistent with the intent of the "have regard" provisions of Section 3 of the Planning Act) to ensure that potential constraints on development resulting from the wetland's eventual and probable status as provincially significant are minimized while ensuring adequate protection of the new habitat.

Except for those restrictions that already exist related to the application of the agricultural policies under the Provincial Policy Statement, it is unlikely that significant new restrictions will be placed on development of lands immediately surrounding the restored wetland.

4.4 Capital and Operating Budgets

Based on the general design concepts described above, an analysis was undertaken to estimate likely capital and operating budgets for the site.

Cost of Site Acquisition

Real-estate values for farmland were evaluated to assess the likely cost of acquiring 1,000 acres for the project. Data describing farm property sales in the study area from the beginning of 1998 to mid 1999 (18 months) were obtained from the Farm Credit Corporation (FCC); 26 sales were identified. Information provided for each sale included:

- Location (lot and concession)
- Date of sale
- Size of the land parcel (total land and arable land)
- Soil type (clay loam, sandy loam, muck)
- Description of structures (type, age, size, and estimated value)
- Purchase price of property ($ per acre)

These data were analyzed to determine the impact of various factors on the price of land. The most important factor, confirmed through discussion with area farmers, was the soil type; sandy loam and muck soils nearer the lake received a premium as vegetable production lands. The overall size of the property appeared to have a negative impact on the unit price. However, given the small number of observations, no significance is attached to this effect. Table 4.3 summarizes the price data for these purchases.

TABLE 4.3
SUMMARY OF PRICE DATA FOR LAND PURCHASES IN THE STUDY AREA

	All Sales		Sand and Muck Soil		Clay loam soil	
	Acres	**Hectares**	**Acres**	**Hectares**	**Acres**	**Hectares**
Total Per Acre Price	$4,320	$10,670	$4,780	$11,800	$3,980	$9,830
Per Acre Price Net of the Value of Buildings*	$4,050	$10,000	$4,510	$11,140	$3,710	$9,160

* Building values were estimated by FCC

This analysis indicates that there is, on average, a differential of $800 per acre between the price of land that will grow vegetable crops and land that is used for a typical corn/soybean rotation.

The cost of acquiring the restoration project site will depend on its potential use for crop production and on the presence of farm buildings. To estimate land costs, we assume that existing homes in the acquisition area are retained by the original owners along with an adjacent area of 1 acre (this assumes that existing buildings are located near roads around the site).

The cost of land is estimated at $4,500 per acre for vegetable land or $3,700 per acre for corn/soybean land. Therefore, the total cost of the site is expected to range from $3,700,000 to $4,500,000 and affect approximately five to eight farms.

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In reviews of preliminary work with these estimates, Local Advisory Committee (LAC) members questioned the average land values described above, suggesting that these were low by $500 or more per acre, particularly for lands suitable for tomato production. There was also concern that some of the existing residential buildings would have to be demolished if located too far away from the road. A sensitivity analysis was conducted to address these concerns, and assess how the economic performance of the site would change with a higher land value. This analysis is discussed in Section 7.

Capital Costs for Facility Development

Estimates of capital costs for facility development are presented separately for a) construction of wetland cells, b) onsite buildings and ancillary facilities, and c) additional complementary habitat.

Construction of Wetland Cells

For the purpose of determining capital costs, it is assumed that the restored wetland is located entirely on farmland. Capital costs for the development of a 1,000-acre wetland include:

- Blocking tile drains and surface drains
- Constructing dykes and land contouring
- Constructing water control structures
- Purchasing and installing pumps
- Removing fences and other small structures
- Removing unwanted buildings
- Constructing onsite facilities

Cost estimates provided by Ducks Unlimited Canada cover the first five items in the above list (West, 1999). Remaining estimates were obtained from local contractors. These costs, summarized in Table 4.4, imply a unit cost of construction between $700 and $1,700 per acre. As shown in Table 4.5, these costs fall within the mid-range of a sample of costs for the simple conversion of agricultural land into wetlands in the United States (converted to 1999 Canadian dollars). (King and Bohlen, 1995).

TABLE 4.4
WETLAND CONSTRUCTION COST ESTIMATES

Configuration	Construction Cost*		
	Low ($50/m of dyke)	Medium ($63/m of dyke)	High ($75/m of dyke)
One Cell	$667,000	$791,000	$915,000
Three Cell	$865,000	$1,039,000	$1,212,000
Four Cell	$989,000	$1,187,000	$1,385,000
Six Cell	$1,187,000	$1,435,000	$1,682,000

* Includes 15% contingency and 7% GST

TABLE 4.5
SAMPLE COSTS FOR CONVERSION OF AGRICULTURAL LAND TO WETLAND

Cost	Per Acre	Per Hectare
Average	$1,600	$3,950
Median	$800	$2,000
Minimum	$8	$20
Maximum	$34,300	$84,700

The high end of this range, in the tens of thousands of dollars per acre, may reflect the need for building removal, excessive land contouring, or other high-cost factors that are not anticipated in the Lake St Clair area. The cost estimates above are therefore considered reasonable for Lake St. Clair.

The base case design assumes a four-cell configuration; therefore, a base case wetland construction cost of $1.2-million is used for further analysis. Costs of $1.0- and $1.4-million were used in variations of the base case design, which featured fewer and more cells, respectively. The low and high cost estimates provide the basis for assigning a low–high range to each cost for purposes of the uncertainty analysis described in Section 8.

Onsite Buildings and Ancillary Facilities

Additional costs associated with the basic design include the cost of a building or buildings and the cost of additional dykes to go around residential properties that are retained. Additional dykes around residential properties are assumed to cost $23,000 (i.e. five properties, 200 m of dyke per property). The main onsite facility is assumed to be a central building to accommodate staff and provide space for volunteers. A basic 500-ft^2 facility would cost approximately $55,000 (at $110/ft^2), while a 3,000-ft^2 building with space for interpretive programs would cost approximately $330,000. An unheated 500-ft^2 workshed is included at $15,000 ($30/ft^2). Total building costs therefore range from $70,000 to $345,000, depending on the configuration.

Additional Complementary Habitat

One of the options under consideration features the addition of small areas of alternative compatible habitat types (i.e. mud flats, wooded swamp, and tall grass prairie). Mud flats differ from the "base" wetland system primarily in the management regime for water levels. No planting costs are anticipated, but there will be some additional construction costs for a dyke to isolate areas. The cost of constructing a mud flat area is assumed to include 600 m of dyke (priced at $75/m to account for additional land contouring in the vicinity of the dyke). A separate water control structure with pump at $40,000 is also assumed. The total cost, including contingencies, is $105,000. Maintenance and management costs will be higher due to more frequent pumping required on an annual basis.

Cost estimates for wooded swamp are highly variable, as shown in Table 4.6 in data from 19 projects in the United States (converted to 1999 Canadian dollars) (King and Bohlen, 1995). These costs reflect earlier experiences with this type of restoration using larger-calibre tree stock at relatively high planting densities. More recent experience indicates good results using 3-ft (1-m) saplings at planting densities that resemble final stand densities. The wooded swamp for this site is assumed to cost $7,000 per acre. This cost includes site preparation and planting and $50,000 for site contouring and dyking. The total cost for a 20-acre site is therefore estimated at $140,000 (Loftus, 2000).

TABLE 4.6
COST ESTIMATES FOR RESTORATION OF WOODED SWAMP

Cost	Per Acre	Per Hectare
Average	$128,000	$316,000
Median	$70,400	$173,900
Minimum	$1,480[1]	$3,700
Maximum	$409,000[2]	$1,000,000

Note: 1. Restoring hydrology only, no planting
2. Includes a research component

The cost of establishing tall grass prairie habitat will depend on the need for site preparation, planting method (seed or plug [seedlings]), and the type of plant mix. A cost of $4,000 per acre for plugs and $3,000 for seed can be expected for initial site preparation and planting a mixture of prairie habitat species, based on recent experience in southwestern Ontario using a mix of native plant species plugs (Ludolph, 1999, personal communication). Ducks Unlimited establishes stands of native grasses for as little as $200/acre using seed (West, 1999, personal communication). However, this program is not a true prairie restoration in that Ducks Unlimited uses a blend of warm season grasses to establish cost-effective upland wildlife habitat adjacent to wetlands. For purposes of costing in this study, a cost of $2,000/acre has been assumed, representing a compromise between the two approaches identified above. Total cost for a 20-acre site is therefore factored at $40,000. General upland habitat could be developed for much less.

Including all three ancillary habitat types in the project would add about $200,000 to site construction costs. Including only mud flats and tall grass prairie areas would add about $150,000.

Including all three ancillary habitat types in the project would add about $200,000 to site construction costs.

Cost Savings

Cost savings may occur if the site adjoins an existing wetland with a shared dyke. For instance, the opportunity to share approximately 600 m of existing dyke could reduce capital costs by about $45,000.

Capital Costs

Capital costs are expected to be contributed by EHJV project partners and will not be recovered from user fees. It is also expected that 65 percent of the capital costs will be contributed by project partners in the United States as part of ongoing commitments under the North American Waterfowl Management Plan (NAWMP).

Operating and Maintenance Costs

Operating and maintenance costs cover the following types of items and activities:

- Dyke maintenance and repair (weed and brush control, maintaining roads and pathways, trapping muskrats, repairing damage from muskrats)
- Water level monitoring and control
- Site patrols to control trespassing
- Biological monitoring (tagging, population, and species assessments)
- Managing public programs (promotions, interpretive services, publications)
- Overhead expenses (utilities, materials and supplies)
- Maintenance of grounds and buildings (lawn care, snow removal, weed control)

Information on operating and maintenance costs is summarized in Table 4.7.

TABLE 4.7
OPERATING AND MAINTENANCE COST DATA

Item	Description	Annual Amount	Source
Individual Cost Items			
Dyke maintenance	Weed control, repairs	$2,500	Ducks Unlimited*
Property tax	Property tax payments or payments in lieu of property taxes if site is tax exempt	$9,000	Calculated
	Program Budgets		
St. John's Marsh	1.5 FTE and 1 seasonal	$80,000	Chapter 5
Tiny Marsh	1 part-time and 1 seasonal	$30,000	Chapter 5
Hullett Marsh	No regular staff	$15,000	Chapter 5

* (West, 1999)

Total annual operating and maintenance costs for the site are assumed at between $40,000 and $80,000. The lower cost represents programming that focuses primarily on wetland habitat functions, whereas the higher cost includes additional funds to promote and support public use and benefits of the site.

Total annual operating and maintenance costs for the site are assumed at between $40,000 and $80,000.

4.5 Summary

The restored habitat will likely consist of a series of three to six wetland cells separated by dykes. Water levels within each cell will be controllable, thereby enabling independent management of each cell.

The design and management of the wetland will focus primarily on maximizing benefits to migrating waterfowl. It is also apparent that the incorporation of ancillary compatible habitats has the potential to increase biodiversity and socio-economic benefits of the project. Therefore, in the final design, consideration is being given to the compatible needs of other migratory and non-migratory species, including vulnerable, threatened and endangered plants and animals. Habitat types that have notionally been included in the general design concepts for detailed evaluation include the following; mudflats (approximately 50 ac.); tall grass prairie (approximately 20-100 ac.); swamp (approximately 20 ac.).

Public access to the site is deemed an important feature by the EHJV partners and the local citizens. Potential benefits to be realized from incorporating public access into the design include revenue generation from user and user fees as well as economic benefits to local and regional businesses.

Table 4.8 summarizes the capital and operating costs detailed in this chapter.

TABLE 4.8
PROJECTED CAPITAL AND OPERATING BUDGET

Site Acquisition	$3,700,000 to $4,500,000
Wetland conservation (4 cell base case)	$1,200,000
Other Costs	
Dykes around residential properties	$75,000
Buildings – enhanced program	$70,000
– basic design	$345,000
Alternative Habitats	
• Mud flat area	$105,000
• 20-acre wooded wetland	$140,000
• 20-acre tall grass prairie	$40,000
• Cost savings for adjoining existing wetland	($100,000)
Other costs for basic facilities	$0.07 to $0.3 million
Costs for other habitats	up to $0.2 million
Total Annual Operating and Maintenance	$40,000 to $80,000

5. Comparative Analysis of Wetland Restoration Projects

5.1 Comparative Sites Analysis

A key step in the methodology was a comparative analysis of other restored wetland sites. Given that there are few suitable empirical studies in the literature, in order to assess the potential effects of the project it was essential to collect and interpret data from professionals experienced in restoring and managing similar habitat from comparative sites within the Great Lakes basin.

This section analyzes wetland restoration and management experiences in several locations with a view to highlighting implications for the proposed project. The following seven sites were selected for analysis:

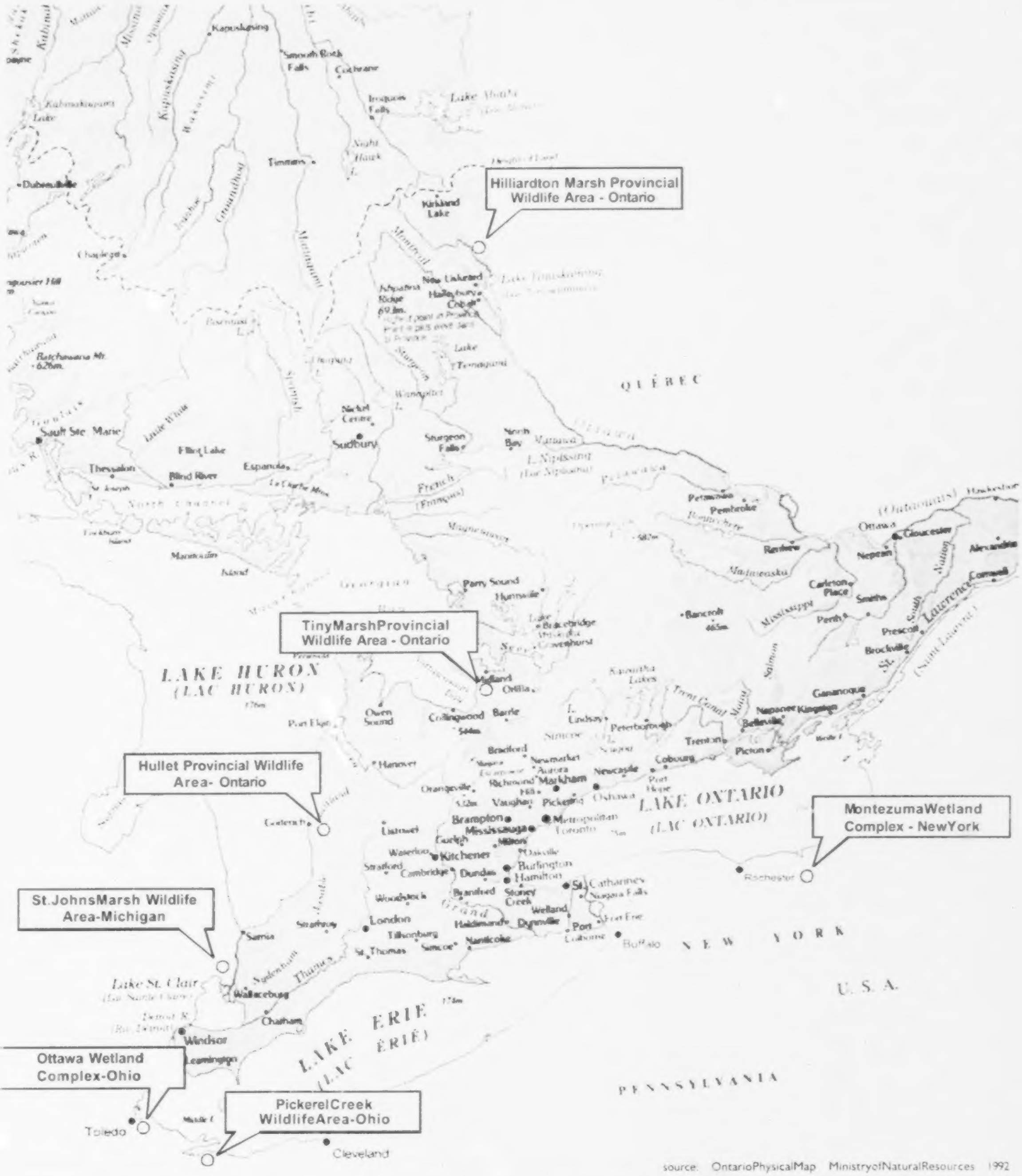
- St. John's Marsh Wildlife Area, Michigan
- Ottawa Wetland Complex, Ohio
- Pickerel Creek Wildlife Area, Ohio
- Montezuma Wetland Complex, New York
- Hullet Provincial Wildlife Area, Ontario
- Tiny Marsh Provincial Wildlife Area, Ontario
- Hilliardton Marsh Provincial Wildlife Area, Ontario

The locations of these sites are presented in Figure 5-1. Sites were selected based on their potential comparability to the Eastern Habitat Joint Venture (EHJV) project and their ability to provide a range of acquisition and management experiences. The St. Clair National Wildlife Area (NWA) was not selected as a comparative site as it does not provide a good comparison in terms of the uses and facilities envisioned for the restoration project.

Each wetland site is described briefly below, followed by a more detailed comparative analysis. A summary table of findings is provided at the end of the section.

5.2 St. John's Marsh Wildlife Area, Michigan

St. John's Marsh Wildlife Area (St. John's Marsh) is a 2,500-acre site located on the St. Clair River delta about 30 miles (48 km) south of Port Huron, Michigan, and less than 50 miles (80 km) northeast of downtown Detroit. The Michigan Department of Natural Resources started acquiring wetland and farmland on the site in 1976, and began dyking and restoring 200 acres of land to wetland in 1988. The restoration


Hilliardton Marsh Provincial Wildlife Area - Ontario
TinyMarshProvincial Wildlife Area - Ontario
Hullet Provincial Wildlife Area- Ontario
MontezumaWetland Complex - NewYork
St.JohnsMarsh Wildlife Area-Michigan
Ottawa Wetland Complex-Ohio
PickerelCreek WildlifeArea-Ohio
QUÉBEC
LAKE HURON
(LAC HURON)
LAKE ONTARIO
(LAC ONTARIO)
LAKE ERIE
(LAC ÉRIÉ)
Lake St. Clair
NEW YORK
U. S. A.
PENNSYLVANIA
Kapuskasing
Cochrane
Timmins
Kirkland Lake
Sault Ste. Marie
Sudbury
North Bay
Ottawa
Kingston
Toronto
Hamilton
London
Windsor
Sarnia
Goderich
Orillia
Barrie
Rochester
Buffalo
Toledo
Cleveland

source: OntarioPhysicalMap MinistryofNaturalResources 1992

Legend

○ Comparative Wetland Locations

Project 118800.TT01	**Date** Jan. 2001
Scale NTS	**Drwn/Chkd** JPC / SND

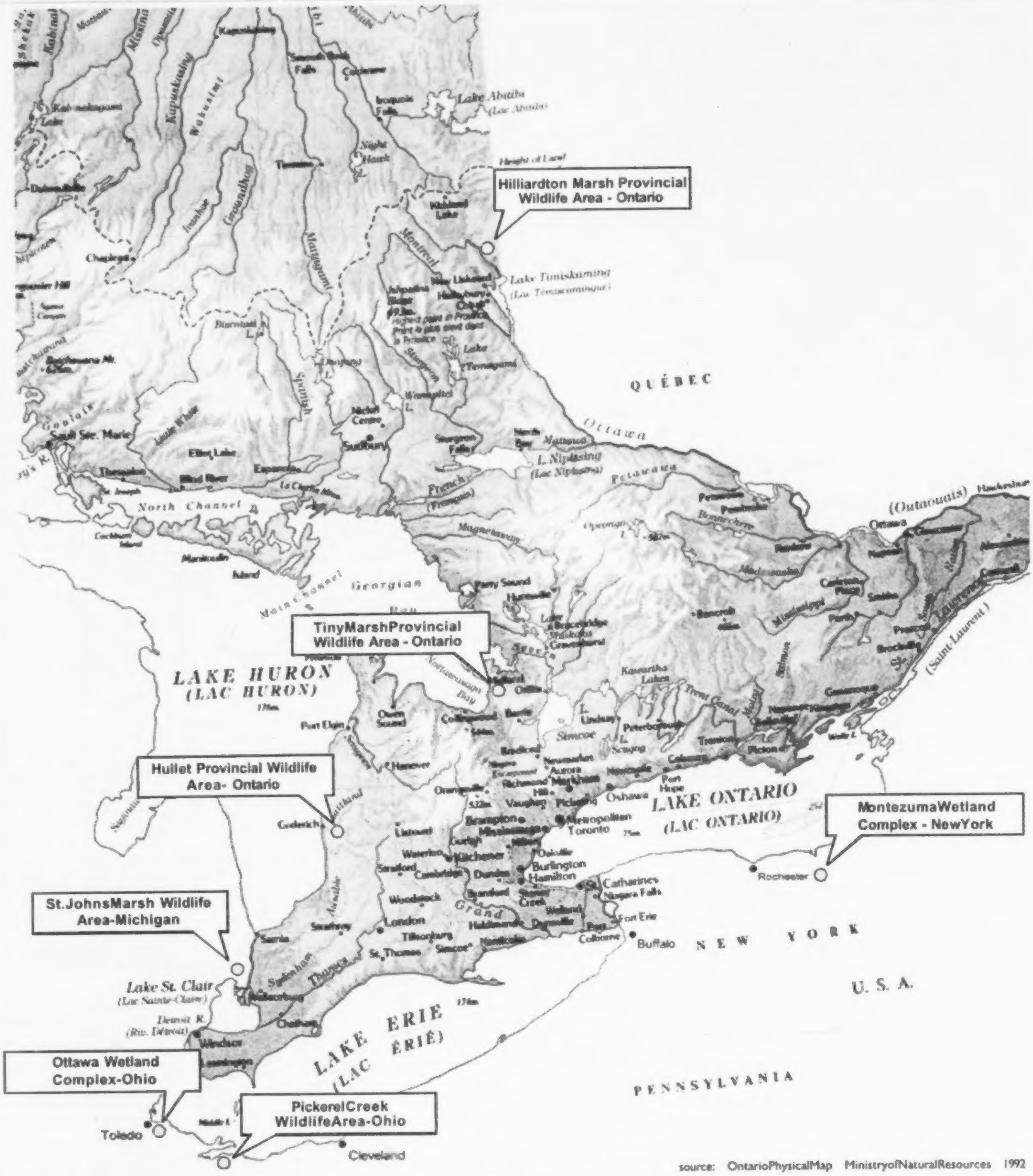
Figure 5-1

Comparative Wetland Locations

1962.01.figure11

CH2MHILL

EHJV-PCJF


Hilliardton Marsh Provincial Wildlife Area - Ontario
TinyMarshProvincial Wildlife Area - Ontario
Hullet Provincial Wildlife Area- Ontario
MontezumaWetland Complex - NewYork
St.JohnsMarsh Wildlife Area-Michigan
Ottawa Wetland Complex-Ohio
PickerelCreek WildlifeArea-Ohio
QUÉBEC
LAKE HURON
(LAC HURON)
Georgian Bay
North Channel
LAKE ONTARIO
(LAC ONTARIO)
LAKE ERIE
(LAC ÉRIÉ)
Lake St. Clair
(Lac Sainte-Claire)
NEW YORK
U. S. A.
PENNSYLVANIA
Lake Abitibi
Lake Timiskaming
Ottawa
L. Nipissing
Sault Ste. Marie
Sudbury
Toronto
Hamilton
London
Windsor
Buffalo
Rochester
Toledo
Cleveland
Goderich

source: OntarioPhysicalMap MinistryofNaturalResources 1992

Legend

○ Comparative Wetland Locations

Project 118800.TT01	**Date** Jan. 2001
Scale NTS	**Drwn/Chkd** JPC / SND

N
W E
S

Figure 5-1

Comparative Wetland Locations

1962.01.figure11

CH2MHILL

EHJV·PCHE

project was completed several years ago. Surrounding land use includes a mix of agriculture and permanent and seasonal residences. The nearest town, Algonac, has a population of 4,500.

The site comprises 1,700 acres of natural coastal marsh, with 200 acres of dyked restored wetland (three cells ranging in size from 8 to 106 acres). Two of the cells are permanent marsh; one is seasonally flooded during the spring and fall waterfowl migrations. The remaining 600 acres is upland habitat, on which some prairie restoration is occurring.

As a state wildlife area, the site is managed to protect wildlife while providing a range of recreational opportunities including hunting, nature viewing, fishing, and education. More than 10,000 users visit the site annually.

5.3 Ottawa Wetland Complex, Ohio

The Ottawa Wetland Complex is an 8,250-acre site comprising the 5,600-acre Ottawa National Wildlife Refuge (Ottawa Refuge), the 650-acre Metzger Marsh Wildlife Area (Metzger Marsh), and the 2,000-acre Magee Marsh Wildlife Area (Magee Marsh). The Ottawa Refuge is federally owned and managed by the U.S. Fish and Wildlife Service; the two marshes are both owned and managed by the Ohio Division of Wildlife. This complex is located along the Lake Erie shore about 15 miles (24 km) east of Toledo, near Oak Harbor, Ohio. Land was acquired for the Ottawa Refuge in 1961, and dyking and wetland restoration started soon after. In total, more than 7,200 acres of wetland have been restored in an area where marshes historically covered 30,000 acres (known as the Black Swamp) until extensive agricultural land drainage occurred earlier this century (U.S. Fish and Wildlife Service, 1963). The surrounding land use is predominantly agricultural, with some seasonal residences and Crane Creek State Park nearby. The nearest town, Oak Harbor, has a population of 2,600.

The Ottawa Refuge, managed by the U.S. Fish and Wildlife Service, contains 200 acres of natural marsh, 4,860 acres of dyked restored marsh (25 cells of 60-500 acres), and about 540 acres of upland. The Metzger Marsh is a single 620-acre dyked restored marsh cell with 30 acres of adjoining upland, and the Magee Marsh is 1,800 acres of dyked restored marsh (10 cells) and 200 acres of upland.

As a federal wildlife refuge, the Ottawa site is managed for wetland-dependent species first, with recreational use as a secondary objective. Activities include nature viewing, hiking, education, and limited hunting. The state-owned Metzger and Magee marshes are managed for wildlife, especially waterfowl, and recreation. Activities include nature viewing, hunting, fishing, and hiking. Additionally, there is a nature centre, a 4,000-ft marsh boardwalk, and a 50-ft observation tower at

Magee Marsh, with swimming along the Lake Erie shore. Bird watching is especially popular at the Magee and Ottawa sites. Total annual visitation to the sites is 100,000 and 115,000, respectively. Many of the Magee visitors also visit the adjoining Ottawa site.

5.4 Pickerel Creek Wildlife Area, Ohio

The Pickerel Creek Wildlife Area (Pickerel Creek) is a 3,000-acre site on Sandusky Bay, about 15 miles (24 km) west of Sandusky and 50 miles (80 km) east of Toledo. The Ohio Division of Wildlife acquired farmland and began to dyke and restore 2,000 acres of farmland to wetland in 1992. The surrounding land use is agricultural and residential. The nearest town, Clyde, has a population of 5,800 and is about 10 miles (16 km) away.

The site comprises 2000 acres of dyked restored wetland (primarily marsh, with some wet forest, open water and wet meadow) in 30 cells ranging from 25 to 300 acres. The remaining 1,000 acres are predominantly upland.

This state wildlife area is managed for wetland-dependent wildlife and recreation. Activities at the site include waterfowl hunting, nature viewing, fishing, and hiking along Sandusky Bay. About 16,000 visitors use the site annually.

5.5 Montezuma Wetland Complex, New York

The Montezuma Wetland Complex (Montezuma Complex) includes more than 36,000 acres of wetland, farmland, small woodlots, grassland, and small rural communities located between Cayuga Lake and Lake Ontario, 30 miles (48 km) west of Syracuse and 40 miles (64 km) east of Rochester. It is a major commitment to the North American Waterfowl Management Plan, and the wetlands in the complex are a registered national natural landmark.

The complex includes the U.S. Fish and Wildlife Service's Montezuma National Wildlife Refuge (Montezuma Refuge) and the New York Department of Environmental Conservation's Northern Montezuma Wildlife Management Area (WMA). The remainder of the complex is mostly private land (predominantly farmland) that is subject to an ongoing public acquisition program by the U.S. Fish and Wildlife Service and New York Department of Environmental Conservation, supported by Ducks Unlimited Inc. and The Nature Conservancy. In the centre of the Northern Montezuma WMA is the community of Savannah, with a population of about 300. On the fringe of the WMA are the communities of Clyde (population 2,400), Port Bryon (population 1,300), and Seneca Falls (population 7,400).

In the nineteenth century, the 40,000-acre Montezuma Marsh extended 12 miles (19 km) northward from Cayuga Lake. By the early 1900s, most of this wetland was lost to agricultural drainage and construction of the New York Barge Canal. In 1932, the state purchased a small portion of the former marsh and established the Howland Island Wildlife Management Area. Between 1933 and 1941 about 300 acres were dyked and restored to wetland. In 1937, the federal government acquired more than 6,000 acres of farmland (former marsh) to establish the Montezuma Refuge. Dyking and wetland restoration started soon after. Currently, the refuge occupies 7,068 acres of land, including 3,600 acres of dyked restored marsh in nine cells ranging from 5 to 1,300 acres in size. Woodlands and grasslands make up the remainder of the refuge. The Northern Montezuma WMA, which incorporates Howland Island, totals 7,657 acres, including 5,360 acres of dyked restored wetland marsh in numerous cells from 5 to 80 acres in size. There are also some natural wet forests on the state-owned lands.

As a national wildlife refuge, the Montezuma site is managed primarily for waterfowl and other migratory birds, but also provides compatible wildlife-dependent recreational and educational opportunities. Facilities include a nature centre, observation towers, a 3.5-mile (5.5-km) self-guided automobile wildlife drive, and a 2-mile (3-km) walking trail. Limited hunting of waterfowl and deer is permitted. Annual visitation to the Montezuma Refuge is almost 140,000, while at least 2,500 visitors use the Northern Montezuma WMA.

5.6 Hullett Provincial Wildlife Area, Ontario

Hullett Provincial Wildlife Area (Hullett Marsh) is a 5,200-acre site located in Huron County, Ontario, near Clinton (population 3,000) and Goderich (population 7,500). Although the area is owned by the Ontario Ministry of Natural Resources, it is managed by Ducks Unlimited Canada in partnership with Friends of Hullett Inc., a not-for-profit group of volunteers.

The site consists of a variety of upland and wetland habitats. Most of the 1,680 acres of wetland have been dyked to create a diverse marsh/open water/flooded willow and timber complex. The area provides recreational opportunities including hunting (waterfowl, upland game, and deer), dog trials, hiking, canoeing, bird watching and nature viewing, and education. Active management in the area includes a focus on increasing opportunities for upland bird hunting, particularly for pheasant. The best estimates suggest that some 5,000 visitors use the area annually; the proportion drawn by or using the wetland area is not clear.

5.7 Tiny Marsh Provincial Wildlife Area, Ontario

Tiny Marsh Provincial Wildlife Area (Tiny Marsh) is located in Tiny Township in north Simcoe County, Ontario. The nearby towns of Elmvale and Wasaga Beach have populations of 1,200 and 5,000, respectively. Some 1,400 acres of marsh are included in the 2,300-acre site. The upland portion of the site contains both natural habitat and agricultural fields that are leased to local farmers for hay production.

The marsh was originally drained in the early 1900s for agriculture; in 1967, the province purchased the area, dammed ditches, and restored wetland. In 1980, with the involvement of Ducks Unlimited Canada, the marsh was divided into three cells for water level management. Tiny Marsh is managed as a multi-purpose recreational area, with the primary objective of diversifying habitat and enhancing waterfowl production.

The site attracts 10,000 to 12,000 visitors annually. The principal activities include general outdoor recreation, hunting, and education. Day-to-day management of the PWA is led by the voluntary charitable M.T.M. (Marl, Tiny, Machedash) Conservation Association.

5.8 Hilliardton Marsh Provincial Wildlife Area, Ontario

Hilliardton Marsh Provincial Wildlife Area (Hilliardton Marsh) is located in the Little Clay Belt in northeastern Ontario. The nearest town, Englehart, has a population of 1,800. The 1,790-acre site consists of 506 acres of marsh, shrub and forested swamp, fen and sphagnum bog complex, as well as adjacent forested and marginal agricultural lands. The marsh area has been divided into four dyked cells; these also include some other wetland types. A portion of the area (778 acres) consists of unalienated Crown lands, and the remainder consists largely of abandoned agricultural lands that reverted to public ownership.

The area was subject to the Class EA for Small Scale MNR Projects and approved for implementation in 1993. The official opening of the Hilliardton site took place in 1996.

The general management objectives provide for biodiversity and recreational benefits, but focus on increasing habitat for waterfowl breeding and rearing. There are no assessments of visitation, although estimates suggest that the number may be in the order of 1,000 annually.

5.9 Comparative Analysis

Restoration of wetland habitat was a key aim in the development of each of the seven sites. The comparative analysis highlights the following characteristics:

- Management objectives
- Activities, services, and facilities provided
- Waterfowl, other wildlife, and wetland management
- Visitation, promotion, and economic impacts
- Relationships with surrounding landowners
- Staffing and budgets

Management Objectives

In the United States, the management objectives for the federally-owned Ottawa and Montezuma Refuges differ somewhat from those for state-owned wildlife areas. As federal refuges, the Ottawa and Montezuma sites are managed primarily as resting, nesting, and feeding habitat for wetland-dependent wildlife, including waterfowl. Wildlife-compatible education and recreation are secondary objectives. On the other hand, the state-owned wetland sites in Michigan, Ohio, and New York give equal emphasis to wildlife and recreation objectives. To varying degrees across the four American wetland sites, attention is also given to managing grassland and forest habitats.

The three provincial wildlife areas differ in specific management objectives, principally reflecting their varying habitat conditions and opportunities for recreational and other activities. In addition to the marsh area, Hullett Marsh has a large area of upland habitat that attracts game and deer hunters and participants in dog trials. Tiny Marsh also contains areas that are attractive to upland game hunters. In the Ontario provincial wildlife areas the management focus is on enhancing waterfowl habitat; however, with a greater potential visitor base in its region, the management of Tiny and Hullett marshes extends more to managing those areas for multi-use recreation. Hilliardton Marsh was established recognizing that the limiting factor concerning waterfowl in the Little Clay Belt was the lack of brood rearing habitat, thus the priority to create and enhance marshes in the region.

Activities, Services, and Facilities

General Recreation

Several recreational activities are permitted at all of the wetland sites, while others are permitted at only one or two. Hiking, nature viewing, photography (including bird watching), and cross-country skiing are permitted at all sites, with no limitations on the number of users. These activities are facilitated by trails at all sites; observation towers at Tiny

Marsh, Hullett Marsh, Magee Marsh, Pickerel Creek and Montezuma Refuge; a 4,000-ft (1,200-m) boardwalk at Magee Marsh and a short boardwalk at Tiny Marsh; picnic sites at Hullett Marsh, Magee Marsh, Montezuma Refuge and Northern Montezuma WMA; and washrooms at Tiny Marsh, Hullett Marsh, Ottawa Refuge, Magee Marsh and Montezuma Refuge. There may be some restrictions to where hiking, nature viewing, and cross-country skiing can occur. For example, use may be confined to hiking trails, boardwalks, and observation areas (e.g. Montezuma Refuge), or specific marsh cells may be designated no-trespassing zones for periods of the year (e.g. Hullett Marsh during waterfowl brooding, Northern Montezuma WMA due to nesting bald eagles). These activities may also be prohibited on specific days when waterfowl, deer, or small game hunting occurs or when bird banding programs are underway. St. John's Marsh, for example, is closed to these activities on the first two days of waterfowl hunting, and hiking trails are closed at Ottawa and Montezuma Refuges during deer hunting. At Hullett Marsh and Tiny Marsh access is restricted in specified sanctuaries and baited areas.

Boardwalk for wetland viewing

Hunting, Trapping, and Fishing

Waterfowl hunting is permitted at all sites, though specific management of hunting and trapping differs from site to site. Blinds are provided at Magee Marsh only. Waterfowl hunting is limited through a lottery system at Ottawa and Montezuma Refuges, Pickerel Creek, and St. John's Marsh. For example, 20 hunting parties of two persons are drawn for each day of hunting. At Hullett Marsh there is a draw for opening day of the season, but the area operates on a first-come, first-serve basis thereafter. There are no limits placed on numbers of waterfowl hunters at the Northern Montezuma WMA. At Hilliardton Marsh, the number of hunters is restricted solely by the number of available parking spaces (10), and access is granted on a first-come, first-serve basis. In the past, when the number of hunters in Tiny Marsh was greater on opening day (up to 700) a limit of 300 free permits was introduced on a first-come, first-serve basis. More recently, as the number of hunters has dropped (typically to about 150 on opening day), no quota system has been used, although fees have been introduced.

Waterfowl hunting is permitted at all sites, though specific management of hunting and trapping differs from site to site.

Deer and small game hunting is permitted at most of the wetland sites, though it may be limited to a few days (e.g. seven days per year at Ottawa Refuge). Bow hunting for deer is permitted at Northern Montezuma WMA and Montezuma Refuge. At Hullett Marsh and Tiny Marsh, the upland area attracts a large number of upland game hunters. Approximately 2,000 pheasant are released annually at Hullett Marsh. Pheasant hunting at Tiny Marsh has been privatized: a single operator provides the service for about 400 hunters annually at a cost of $25 per hunt (two-bird limit).

Trapping is permitted at all sites. Trapping rights at Ottawa and Montezuma Refuges are granted to the highest sealed bid, while trapping by permit or draw is permitted at the other wetland sites. Single individuals hold trapping rights in each of the Ontario provincial wildlife areas.

Fishing is not permitted in marsh cells, except at Tiny Marsh, St. John's Marsh, and Metzger Marsh. Fishing is permitted along the Lake Erie shore at Magee Marsh, along the Sandusky Bay shore at Pickerel Creek, and in canals adjacent to Montezuma Refuge. Only canoes and car-top boats are permitted in the Northern Montezuma WMA, no motors are allowed at Hullett Marsh, and boating is permitted in the coastal (undyked) area at St. John's Marsh.

Education

Nature interpretative tours and school programs are offered at each of the wetland sites except Pickerel Creek and Metzger Marsh. These services are available only by appointment at Hullett Marsh, Ottawa Refuge, St. John's Marsh, and Northern Montezuma WMA. In 1998, 17,400 people visited the nature centre at Montezuma Refuge, and onsite environmental education was provided to 3,000 students and 400 teachers. At Tiny Marsh, interpretation and school programs are operated through the privately operated Bluewater Interpreters. A single individual can have a significant impact: at Hilliardton Marsh the number of school visits (approximately 650 student-days in 1999) and other student activities (approximately 240 student-days) have been attributed to the leadership of one teacher. Interpretation is facilitated at Tiny Marsh, Magee Marsh, and Montezuma Refuge by nature or visitor centres. Such centres are planned for Hullett Marsh, Hilliardton Marsh, and Northern Montezuma WMA.

Students visiting wetland

Research occurs at most of the wetland sites, by staff stationed at the sites or by other researchers.

Site Access and Fees

Motorized vehicle access is not permitted at most of the wetland sites. All-terrain-vehicle use is prohibited at all sites, although snowmobile trails pass through portions of Tiny Marsh and Hullett Marsh. Bicycling is not permitted at the Montezuma Refuge, even along the automobile wildlife drive. Bicyclists and hikers are more disturbing to most wildlife than people in cars (the cars act as a blind), and therefore are not permitted on the wildlife drive. Of note, staff have prepared an information sheet explaining to visitors the necessity for some restrictions on recreational use.

With only a few exceptions, fees are not charged for activities, services, and facilities at the wetland sites. There are fees for trapping at Ottawa and Montezuma Refuges and Magee Marsh, and normal license fees for trapping at the Ontario sites. There is a modest fee for waterfowl hunting at the Ottawa and Montezuma Refuges. At Tiny Marsh, both waterfowl and pheasant hunters pay a daily fee (and, in the case of waterfowl hunters, can purchase an annual season pass). A season membership is collected for hunters at Hullett Marsh. Other users in some sites may pass by a donation box.

Waterfowl, Other Wildlife, and Wetland Management

The Montezuma Complex has historically been significant to waterfowl and other migratory birds using the Atlantic flyway. The other comparative wetland sites are important in the context of both the Mississippi and Atlantic flyways. Hilliardton Marsh is located in a key region for waterfowl for both spring and fall migration to and from the Hudson Bay Lowlands.

All of the sites contain a range of wetland and upland habitats, although emergent marsh is often dominant. Grasslands and wet forests are important habitats at the Northern Montezuma WMA; the wet forests or swamps are particularly critical to warblers and other neotropical migrants. The marshes and adjacent Lake Erie beaches at the Ottawa Complex and Pickerel Creek are important to migratory shorebirds. Upland areas, generally agricultural and former agricultural lands, comprise the greatest area of Hullett Marsh and a significant part of Tiny Marsh and Hilliardton Marsh. The diversity of wetland types is greatest at Hilliardton Marsh, where the area includes marsh, shrub and treed swamp, fen, and bog.

Waterfowl Population

Data on waterfowl numbers are available for six of the seven sites. Unfortunately, a variety of different measures are used as the basis of the counts (e.g. peak numbers during migration, average numbers, annual total usage, and waterfowl-days of use). As a result of this inconsistency, the data are not directly comparable and, given the variety of measures and census methods, any comparison would be suspect.

Staff at St. John's Marsh report 250 breeding ducks, 40 breeding geese, and 40 breeding swans in summer. The numbers indicate a total of 15 to 20 thousand duck-days, 300 goose-days, and more than 2,000 swan-days of use during migration.

At the Ottawa Refuge, staff calculate use numbers by waterfowl days (i.e. the total of the daily numbers during the migration period). These statistics indicate a usage of about 5,000 resident duck-days, 2,000 resident goose-days and 20 resident swan-days and migratory use of 45,000 duck-days, 15,000 goose-days, and 550 swan-days.

At the Montezuma Refuge, summer waterfowl residents total 2,000 ducks and 250 geese, with migration numbers peaking at 200,000 ducks, 150,000 geese, and 1,000 swans.

At Hullett Marsh, there are about 500 ducks and 500 geese resident in the area, with peak numbers reaching 5,000 ducks, 500 swans, and an unknown number of geese during fall migration.

Staff at Tiny Marsh report 1,500 resident ducks, 800 geese, and 2 swans. Migration numbers peak at 4,000 ducks, 1,000 geese, and 4 swans.

Some sense of the variety of ducks using the larger wetland sites can be gained from a November 17, 1998 duck count at Magee Marsh. Dabbling ducks observed included 925 gadwalls; 455 mallards; 325 green-winged teal; 95 wigeons; and 30 black ducks; other ducks observed included 30 ring-necks and 30 mergansers. On the same day, at Pickerel Creek, 75 green-winged teal, 70 mallards and 2 black ducks were observed. At the Northern Montezuma WMA, eight species of duck are known to breed. At Hilliardton Marsh, the 1998 duck banding results count 362 mallards, 40 wood ducks, 20 blue-winged teals, and five other species.

Other Species

While waterfowl are important target species in managing wetlands at all the sites, management considers all native wetland-dependent species and other wildlife and habitat. Neotropical migrants, including warblers, are of considerable interest at the Montezuma and Ottawa sites, shorebirds at the Ottawa and Pickerel Creek sites and osprey, and bluebirds and flying squirrels at Tiny Marsh. Grasslands are actively managed at the Montezuma and St. John's sites, and upland habitat at Tiny Marsh and Hullett Marsh. Seeds for prairie plant re-establishment at St. John's Marsh were obtained from Lambton County, Ontario.

While waterfowl are important target species in managing wetlands at all the sites, management considers all native wetland-dependent species and other wildlife and habitat.

Managers at each site were asked to list endangered, threatened, or unusual species or habitats at their sites. These responses are summarized in Table 5.1.

A wide range of habitat and species management practices are carried out at the wetland sites. Sites use water level manipulation of wetlands, trapping, chemical control, hand removal of exotic vegetation such as purple loosestrife, and nest boxes. Burning of vegetation is not undertaken at the Ontario sites, but is practised at all U.S. sites except the National Wildlife Refuge portion of the Ottawa Complex. Biological control of purple loosestrife is practised at the St. John's, Ottawa and Montezuma sites, though with limited success at the Ottawa Refuge. Loosestrife is not identified as a particular issue at the Ontario sites; control, if needed, is usually undertaken by hand pulling or localized spraying. Warm season grasses are planted for ground-nesting species at the Montezuma site and Hullet Marsh, and native prairie grasses are planted at St. John's Marsh. Mechanical control of vegetation is practised at the St. John's and Ottawa sites.

TABLE 5.1
ENDANGERED, THREATENED, OR UNUSUAL SPECIES AND HABITATS

Habitat	Species
Hullett Marsh	Least Bittern Black Tern
Tiny Marsh	Black Tern Least Bittern
Hilliardton Marsh	Yellow Rail Black Tern Peregrine Falcon
St. John's Marsh	King Rail Eastern Fox Snake
Ottawa Complex	Bald Eagle Common Tern Cerulean Warbler Deer's Tongue Arrowhead Wapoto Wild Rice Leafy Tussock Sedge
Pickerel Creek	Eastern Fringed Prairie Orchid Wet Meadow
Montezuma Complex	Bald Eagle Cerulean Warbler Black Tern Pied-Billed Grebe Peregrine Falcon Globally-Threatened Salt Marsh Floodplain Swamp

Visitation, Promotion, and Economic Impacts

Visitation

Table 5.2 shows annual visitation estimates, by type of activity, for each of the comparative sites. Reasonably detailed data are available only for the Montezuma Complex. With the exception of the St. John's Marsh, where fishing is very popular, wildlife observation is generally the dominant activity (with its long season of activity), with much smaller levels of waterfowl and other hunting. The proportion of hunters to total visitation is higher on the state-owned Pickerel Creek and St. John's Marsh and at Hullett Marsh.

There is some variation in the drawing power of the various wetland sites. Managers were asked to estimate the percentage of visitors from each of the following origins: local (within a half-hour drive), regional (within a half to two hour drive), and distant (more than a two hour drive). Table 5.3 shows these estimates. In the United States, not surprisingly, the smaller state-owned sites attract visitors from more local origins, while the federal refuges tend to draw visitors from more distant origins. Notable, however, is Magee Marsh adjacent to the Ottawa Refuge. The Magee Marsh appears to be well known to bird

TABLE 5.2
ANNUAL VISITATION BY ACTIVITY

Activity	Hullett Marsh	Tiny Marsh	St. John's Marsh	Ottawa Complex	Pickerel Creek	Montezuma Complex
Total visitation	≈5,000	≈10,000-12,000	10,000+	115,000 ONWR 100,000 Magee	≈16,000	139,500 MNWR 2,500 NMWMA
Wildlife observation	Unknown	≈8,000-8,500	≈1,000	Most of the total visitation	≈10,000	112,400 MNWR
Waterfowl hunting	The greatest proportion of visitation	≈500-800	≈500		≈6,000	400 MNWR
Other hunting	1200	≈500	≈400			1,300
Environmental education	≈500	≈1,000-2,000				3,400*
Trapping						400
Fishing		Few	≈8,000			2,900

* Offsite environmental education is 106,000 persons annually

TABLE 5.3
DISTANCE TRAVELLED (IN TIME ONE WAY) TO THE WETLAND SITES (PERCENT OF VISITORS)

Distance Travelled	Hullett Marsh	Tiny Marsh	Hilliardton Marsh	St. John's Marsh	Ottawa Complex	Pickerel Creek	Montezuma Complex
Local (less than 0.5 hour)	15%	50%	50%	80%	50% ONWR 40% Magee	70%	30% MNWR 70% NMWMA
Regional (0.5 to 2.0 hours)	80%	45%	45%	15%	25% ONWR 30% Magee	20%	35% MNWR 20% NMWMA
Distant (more than 2 hours)	5%	5%	5%	5%	25% ONWR 30% Magee	10%	35% MNWR 10% NMWMA

watchers (Kerlinger, N.D.) and has a nature centre, which the adjacent refuge does not. In Ontario, Hullett Marsh has a larger draw regionally than do the other two sites. Tiny Marsh and Hilliardton Marsh each draw half of their visitation locally. Hullett's attraction for hunting and hunting related activities (i.e. dog trials) appears to account for more of a regional draw than the other sites.

One measure of the attraction of a recreational site is the amount of repeat visitation. Data are available only for Magee Marsh and Montezuma Refuge. Almost 77 percent of visitors to Magee Marsh are repeat visitors (Kerlinger, N.D.). At Montezuma, 46 percent are repeat visitors who visit the refuge an average of 6.2 times a year (Montezuma NWR, N.D.). Repeat visitation is generally seen as representing a high proportion at the three provincial wildlife areas in Ontario.

Although the entire summer period is generally busy, many managers reported the largest number of visitors during October-November and April-May, corresponding with fall and spring migrations of waterfowl, songbirds, and other birds. August is also a busy month at Pickerel Creek because of shorebird migration. Dog trials during spring and summer attract many visitors to Hullett Marsh. Detailed monthly visitation data are available only for Montezuma Refuge as shown in Table 5.4.

TABLE 5.4
MONTHLY DISTRIBUTION OF VISITATION AT MONTEZUMA REFUGE, 1994-98 AVERAGE

Month	Average	% of Annual	Month	Average	% of Annual
January	320	0.2%	July	11,960	9.1%
February	706	0.5%	August	15,660	12.0%
March	7,240	5.5%	September	15,140	11.6%
April	16,840	12.9%	October	21,020	16.1%
May	17,320	13.2%	November	8,820	6.7%
June	12,380	9.5%	December	3,520	2.7%

This monthly distribution is likely typical of the other sites. October and May account for almost 30 percent of annual visitation to the Montezuma Refuge.

Promotion

All of the sites are marked by roadside signage, and all sites except St. John's Marsh and Hilliardton Marsh have their own brochures and descriptions in local tourism brochures. Only the Ottawa and Montezuma refuges and the Northern Montezuma WMA use direct mailings to past users or others and have promotional campaigns. For the Ottawa Refuge, a promotional campaign involves entering a float in local festivals and parades. The Ottawa Refuge and Northern Montezuma WMA have newsletters. Hullett and Tiny Marshes and the

Ottawa and Montezuma Refuges have web-sites for advertising and promotion. Paid advertisements in newspapers, magazines and radio/TV are not used to any extent. Some special events may be advertised, for example the auto tours offered by the Ottawa Refuge and the dog trials at Hullett Marsh. Magee Marsh has a low-power radio broadcasting system to provide visitors with information, and the Montezuma Refuge plans to install a similar system. The federal wildlife refuges tend to be more heavily promoted than the other wildlife areas.

Managers were asked to indicate the most effective method(s) of promoting their wetland site. Most managers noted the importance of word of mouth. Managers of the high-visitation Ottawa and Montezuma Refuges and Magee Marsh mentioned the value of newspaper and magazine articles about the sites.

Economic Impacts

All comparative wetland sites are located in rural areas, with at least one small community within a few miles and larger urban areas within an hour's drive. Managers were asked to note any nearby businesses that might be somewhat or entirely dependent economically on the wetland site. Restaurants are reported in the vicinity of all sites, and gas stations are near all but Pickerel Creek. There are two private campgrounds near the Ottawa Complex and one near Pickerel Creek. Tourist operators at Elk Lake benefit from Hilliardton Marsh. There are motels in the vicinity of the Ottawa and Montezuma Complexes, and local hotels offer accommodation to hunters and dog trial participants at Hullett Marsh. There are bait and tackle and sporting goods establishments near Hullett Marsh, St. John's Marsh and the Ottawa and Montezuma Complexes. A variety of other businesses are located in several small communities in the vicinity of the Montezuma Complex and other sites. A reconnaissance of the Montezuma Complex revealed that some nearby landowners charge hunters for access to their fields; however, it is not known how widespread this practice is at any of the sites.

Apart from a canoe rental establishment near St. John's Marsh and Bluewater Interpreters and a pheasant guiding business at Tiny Marsh, site managers were of the opinion that none of the local businesses are largely dependent on the wetland sites. Managers were unsure of the extent to which the wetland sites create local business development opportunities.

Data on visitor spending were available for only Magee Marsh, Ottawa Refuge and Montezuma Refuge. A 1993-94 survey of visitors to Magee Marsh (many of whom also visited Ottawa Refuge) was coordinated by the Black Swamp Bird Observatory (Kerlinger, N.D.). The aim of this survey was to estimate the local economic impact of birders. Responses were obtained from 455 bird watchers, 78 percent of whom reported staying in the area for more than one day (average of 2.5 days). Average local expenditures on lodging, meals, gasoline and other items were estimated to be $29.00 per person, per day. The study applied this average to an estimated 193,500 birders visiting the Ottawa Complex between August 1993 and July 1994 to derive a total direct local impact of $5.6 million. Also of interest is the finding that 95 percent of visiting birders combined their trip to the Ottawa Complex with visits to other birding sites, including Pickerel Creek.

A 1995-96 survey of visitors to the Montezuma site was completed by refuge staff. The 658 respondents represented all activity types (56 percent were birders). Nineteen percent of respondents reported that they would be staying more than one day (average of 2.7 nights within 20 miles). All respondents were asked to estimate expenditures within 20 miles of the refuge; the average estimated expenditure for the 305 respondents was $122.36 per visit (Montezuma NWR, N.D.). For this proportion of visitors, this represents some $7.9 million in annual local spending. It is possible that some respondents included expenditures for other members of their party; conversely, many non-respondents to this question will have incurred some local expenditures not reported above.

Relationships with Surrounding Landowners

Site managers were asked to describe complaints received from landowners within the vicinity of their site. Managers for the federal wildlife refuges reported that they do not receive landowner complaints. However, apparently there is some lingering bitterness over expropriation of some of the land acquired for the Ottawa Refuge. Some complaints are received from landowners surrounding the St. John's and Pickerel Creek sites and the state-owned portion of the Montezuma Complex. Smoke from burning prescribed for wetland management at St. John's Marsh and Pickerel Creek generated several complaints from local residents, though apparently the complaints at Pickerel Creek were not justified. Residents occasionally complain about hunters at St. John's Marsh, and about trash that is sometimes left on dead-end roads in the area. Pickerel Creek receives one or two complaints a year from residents about a dog in their backyard. Problems regarding the traffic generated by Saturday morning duck hunts at Hullett Marsh have been addressed by providing temporary parking for hunters arriving before 5 a.m. The only complaints at Hilliardton Marsh have been related to enforcement of hunting activities.

Crop depredation does not appear to be a concern for surrounding landowners.

Crop depredation does not appear to be a concern for surrounding landowners. Part of the reason for this complacency is due to changes in harvesting machinery that reduce the potential for fall depredation. Only at the Northern Montezuma WMA and Tiny Marsh was the issue even identified by the managers. The issue was raised during the development of Hilliardton Marsh, but has never been identified as a problem since the area was re-flooded. At the Northern Montezuma

WMA there is a hint of concern over crop depredation, but this was the case even before land acquisition for the site was initiated in 1992. At Tiny Marsh farmers seem to simply accept some goose damage in spring, in part because they see an advantage to the marsh's presence providing a stable water table, especially in dry years.

Compensation to local governments for property tax revenue lost to public land acquisition is an issue with the Northern Montezuma WMA, particularly because of the scale of project (7,600 acres of state-owned land, and possibly growing to 20,000+ acres). New York State does not currently have any mechanism to compensate local governments for lost tax revenue (e.g. payments in lieu of taxation). In contrast, the federal government provides such compensation for the Montezuma and Ottawa Refuges, as do Michigan (for St. John's Marsh) and Ohio (for the Metzger Marsh, Magee Marsh and Pickerel Creek). The arrangement in Ohio is at the rate of 1 percent of the total assessed property value in the municipality, which is quite minimal. The Michigan arrangement also does not fully compensate for land lost to the tax base.

In Ontario, the province provides grants in lieu of taxes to local municipalities for provincial wildlife areas.

In Ontario, the province provides grants in lieu of taxes to local municipalities for provincial wildlife areas; these grants are equal to the municipal tax portion of property taxes. Although an equivalent of school taxes is not provided, the difference is made up in direct grants to school boards. This effectively makes the establishment of these areas revenue-neutral from the point of view of local taxation. In Hilliardton, a portion of the area is unpatented land; therefore, no taxes for this area would be assessed in any case.

Some additional insights regarding relationships with surrounding landowners relate to the Ottawa Refuge and Northern Montezuma WMA. The Ottawa site has managed a cooperative farming program for some time, through which 200 acres of the refuge remains in agricultural production. If corn is grown, one-third of the crop is left in the field for waterfowl. If soybeans are grown, the farmer gives the refuge one-third of the income from the crop. This program has been a link to the local farming community, and has probably helped to reduce crop depredation. However, in response to a number of complaints about corn being grown on a National Wildlife Refuge, presumably from refuge users, the cooperative farming program is being phased out.

A somewhat similar arrangement exists at Hullett Marsh. Approximately 750 acres of the area are leased out for agricultural production. The contract is tendered every five years and includes a provision that the farmer provide, from production, the feed used in the PWA bait stations. Baiting is seen as one means of retaining waterfowl within the site, thereby reducing potential crop depredation in nearby fields.

Perhaps the most valuable insights can be gained from the experiences surrounding the Montezuma wetlands initiative. As noted above, land acquisition has been ongoing since 1992, with the prospect of acquiring an additional 20,000 acres of rural land. Acquisition has been on a "willing seller" basis. Initially, there was considerable local opposition to the project because of the loss of farms and loss of local tax revenue. Project managers spent a great deal of time talking to civic groups and landowners in an effort to explain the project and address concerns. Some of the actions taken by managers to address concerns and "sell" the project include the following:

- A private land wetland restoration program, which restores small areas of wetland (e.g. using ditch plugs) on private land at no cost to participating landowners
- Staging acquisition and restoring wetland soon after acquisition so that local residents can see some action occurring, rather than land sitting idle
- Permitting agriculture to continue on some 800 acres of acquired land, on a rental basis, because some farming practices benefit wildlife (idle land promotes purple loosestrife)

Apparently there is now a growing recognition within the local communities that wildlife-related recreation and tourism can be a basis for economic development. The Town of Savannah, in the middle of the Northern Montezuma WMA, now has a Chamber of Commerce and is developing a town plan based on eco-tourism.

Staffing and Budgets

Table 5.5 shows the staffing and annual operating budgets for the wetland sites. Minimal income is generated from users of these sites. Trapping generates $1,500 and hunting fees generate $2,000 at Ottawa Refuge; there are fees for trapping at the other sites as well. The state generates income from the sale of souvenirs at birding events on the Northern Montezuma WMA, and sales of books and other items at the nature centres at Montezuma Refuge and Magee Marsh also generate income.

5.10 Summary

The seven wetland sites studied in this comparative analysis represent a range of wetland restoration projects in terms of size, age, level of facilities, visitation, and other characteristics. Some of these characteristics are summarized in Appendix F.

All of the sites represent wetland restoration projects involving the reflooding of land, typically agricultural land. Dyked wetland cells range from 5 to 1,300 acres in size, with an average for all seven sites of about 300 acres. The oldest restoration project is at Montezuma, dating to the 1930s; the most recent is at Hilliardton, where dyking was undertaken in the mid-1990s.

TABLE 5.5
STAFFING AND ANNUAL OPERATING BUDGET

	Staff	Budget
Hullett Marsh	None (resources provided through MNR District Office)	Cdn $15,000
Tiny Marsh	1 part-time and 1 seasonal	Cdn $30,000
Hilliardton Marsh	2 part-time	Unknown
St. John's Marsh	1.5 FTE and 1 seasonal	US $80,000
Ottawa Complex	8.5 FTE and 9 seasonal at Ottawa Refuge	US $640,000 for Ottawa Refuge
	4.5 FTE and 1 seasonal at Magee WA	US $200,000 for Magee WA
Pickerel Creek	3.5 FTE and 3 seasonal	Not available
Montezuma Complex	8.2 FTE and 1 seasonal at Montezuma Refuge	US $600,000 for Montezuma Refuge
	1.5 FTE and 1 seasonal at Northern Montezuma WMA	US $100,000 for Northern Montezuma WMA

All of the sites are actively managed. Notably, some degree of water level manipulation is practiced at all sites. Burning is practiced at three of the U.S. sites, and chemical control of vegetation is generally undertaken at all sites, although purple loosestrife is not considered a particular issue at the Ontario sites. One of the managers suggested that opportunities for habitat management were greater in larger marsh cells.

Waterfowl are an important management focus at all of the sites. However, other wetland-dependent species of animals and plants are also important, including a number of rare, endangered, and unusual species mentioned by wetland managers at six of the seven sites. The focus of management appears to be broadening even beyond wetland species, for example, prairie grassland management and management of other upland habitats is important at several of the sites.

A varying number of tourist and recreation oriented businesses are found in the vicinity of each of the wetland sites. The greatest number of these is found near the largest site, the Montezuma Complex. The fewest are found near Pickerel Creek, St. John's Marsh, and Hilliardton Marsh. A number of businesses benefit from local spending by wetland users. In fact, economic impact studies of the Ottawa and Montezuma Complexes, which attract large numbers of users, show annual local spending of almost six million and eight million dollars US, respectively. However, managers identified only a handful of specific business establishments that were totally dependent, economically, on wetland users.

Crop depredation is not a significant concern at any of the wetland sites. At a couple of the U.S. sites, smoke from prescribed burning and hunters and/or their dogs have been the cause of minor complaints from rural residents. A more serious concern at several of the U.S. sites is the impact of the site on the local property tax base. This is particularly a problem at the Montezuma Complex because New York State has no mechanism to compensate local governments for lost tax revenue due to the restoration project of Wildlife Management Areas. Compensation arrangements exist in Ohio and Michigan, but are not generous. In contrast, Ontario's mechanism for compensation makes the establishment of Provincial Wildlife Areas more or less revenue-neutral in terms of local taxation.

6. Biological Impacts and Values

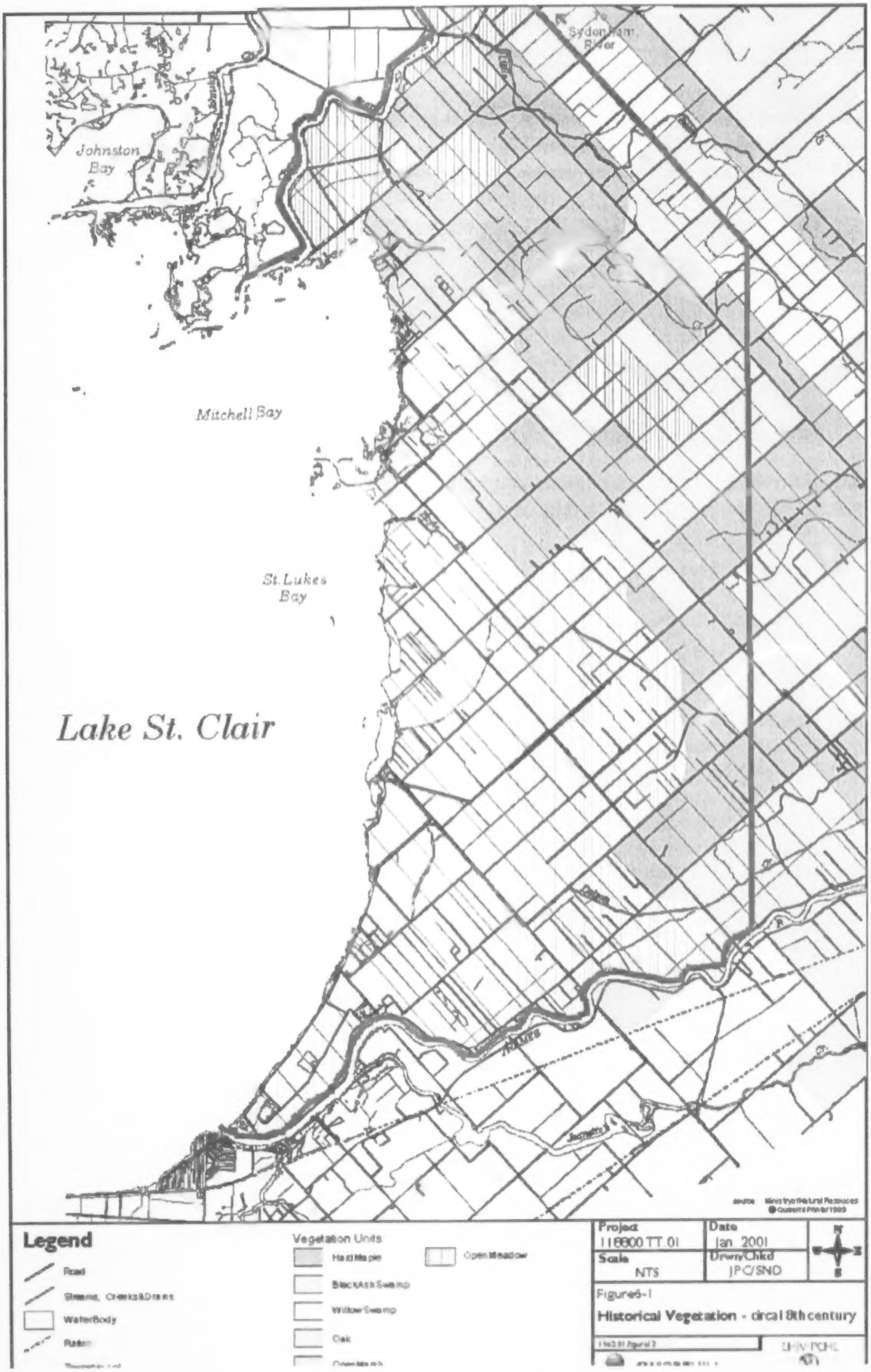
6.1 Background

Tall grass prairie vegetation

Land surveyor records from the late 18th to the early 19th century reveal that much of the Study Area was covered by "open meadow" vegetation (Figure 6-1). Although the term is ambiguous, "open meadow" likely refers to what is now called tall grass prairie as well as meadow marsh. These vegetation communities were subject to flooding events associated with the lake and the Thames River. Additional wetlands were no doubt present along Lake St. Clair itself and subject, as they are today, to lake level influences. Further inland, upland deciduous forests and deciduous swamps occurred in equal extent.

Edsall et al. (1988) report that along the Ontario shoreline of Lake St. Clair, 11,772 acres (4,764 ha) or 34 percent of coastal wetlands were lost in the delta and the lake areas between 1873 and 1968. Wetlands along the eastern shoreline of the lake were reduced dramatically between 1873 and 1968, from approximately 1.5 miles to 0.5 miles wide (2.5 km to 0.8 km). The conversion of wetlands to agriculture was the principal reason for this loss. Wetlands along the eastern shore of the lake, from the mouth of the Thames River to Chenal Ecarté, further decreased by 2,629 acres (1,064 ha) between 1965 and 1984 (McCullough, 1985). Agricultural drainage was the principal cause of this additional decline (89 percent) although some loss was due to marina and cottage development (11 percent). The wetlands on the Ontario side of the St. Clair Delta are intact in many places, but shoreline development, dredging, and placement of dredge spoils created impacts. Between 1965 and 1978, 1,255 acres (508 ha) or 4.5 percent of the wetlands on Walpole Island were lost (McCullough, 1982). Since 1978, wetland loss due to agricultural and urban development has continued in the lake and delta, albeit at a slower pace than in previous years (D. Hector, personal communication).

Current wetland mapping from the Ontario Ministry of Natural Resources (OMNR) shows the wetland area in the Study Area to be approximately 4,806 acres (1,945 ha). This figure varies considerably due to the fact that lake levels affect a large percentage of the coastal wetlands. High lake levels over the last decade resulted in a significant loss of coastal wetlands in St. Luke's Bay. However, low lake levels over the last two years have resulted in the re-establishment of some coastal wetlands. Continued low lake levels, which are predicted for the near future, will encourage the spread of wetland vegetation further into the lake.


To Sydenham River
Johnston Bay
Mitchell Bay
St. Lukes Bay
Lake St. Clair
Thames
Jeannette's
Legend
Road
Streams, Creeks&Drains
WaterBody
Railway
Vegetation Units
Hard Maple
Black Ash Swamp
Willow Swamp
Oak
Open Meadow
N
W
E
S

source: Ministry of Natural Resources
© Queen's Printer 1989

Project	Date
118800 TT.01	Jan 2001
Scale	Drwn/Chkd
NTS	JPC/SND

Figure 6-1

Historical Vegetation - circa 18th century

Although a substantial portion of the wetlands is still in existence, most of the remnant wetlands in the area are under a variety of stresses (Maynard and Wilcox, 1997; Reid and Holland, 1997; Chow-Fraser and Albert, 1999). Urban, recreational, and agricultural encroachment not only cause wetland loss but also stress remaining wetlands through fragmentation. Shoreline alteration, through bulkheading and dyking associated with urban areas and agriculture, severs the natural ecosystem processes between the wetlands and the lake and prevents the landward migration of the wetlands during periods of high water. Dyking can also prevent or impede the use of wetlands by fish for spawning, nursery or feeding. Bookhout et al. (1989) estimate that about half of the wetlands in Lake St. Clair and the St. Clair Delta have been dyked.

Although the Lake St. Clair area has been substantially altered from its original state, it retains remnant natural areas and ecological values of exceptional significance. For example, the Lake St. Clair shoreline (delta and eastern shoreline) was identified as a Biodiversity Investment Area at the State of the Lake Ecosystem Conference (SOLEC) in 1998 because of its aquatic ecosystems (Koonce et al., 1999), coastal wetland ecosystems (Chow-Fraser and Albert, 1999) and nearshore terrestrial ecosystems (Reid et al., 1999). Much of the significance attributed to the area is due to the considerable numbers of endangered, threatened, and vulnerable species present there.

The Lake St. Clair shoreline was identified as a Biodiversity Investment Area in 1998 because of its aquatic ecosystems, coastal wetland ecosystems, and nearshore terrestrial ecosystems.

The restoration of a 1,000 acre (405 ha) wetland would increase the area of wetlands in the Study Area by approximately 21 percent. This section will discuss the probable effects of the proposed wetland restoration on waterfowl and biodiversity.

6.2 Effects on Continental and Regional Waterfowl Populations

Background

In 1999, waterfowl in North America were estimated at 43.4 million birds, the largest estimated population since operational surveys began in 1955 (U.S. Fish and Wildlife Service 1999). Total waterfowl population estimates in 1999 were 32 percent higher than the 1955-98 average. In the Lake St. Clair area, mallards, which represent about half of all waterfowl during Fall migration (based on 1982 census of waterfowl-days (Dennis and North, 1984)) were estimated at 47 percent higher in 1999 than the 1955-98 average (U.S. Fish and Wildlife Service). Estimates in 1999 of gadwall, green-winged teal, blue-winged teal, northern shoveller, redhead, and canvasback were above their respective long-term averages; however, estimates of pintail, and scaup remained below their long-term averages.

Three to seven million waterfowl migrate annually through the Great Lakes region (Bookhout et al., 1989; EHJV, 1994; McCullough, 2000). Although substantial waterfowl production occurs in some areas, the main function of Great Lakes marshes is the replenishment of energy expended during waterfowl migration (Hoffman and Bookhout, 1985). Bookhout et al. (1989:143) state that "in the face of declining amounts of marsh, with concomitant concentration of waterfowl, the quality of the remaining Great Lake marshes is of critical importance to migrating waterfowl".

Lake St. Clair is the second most important staging area for waterfowl along the Canadian shoreline of the Great Lakes with more than 8.6 million annual waterfowl use days (Spring and Fall combined) (Dennis et al., 1984). Reid et al. (1999) state that over a million waterfowl use Lake St. Clair annually. Peak numbers of waterfowl using the Lake St. Clair marshes are estimated at 60,000 and 150,000 in Spring and Fall, respectively (Dennis and North, 1984). The marshes along the eastern shoreline of Lake St. Clair are the most important staging areas in southern Ontario for mallards, black ducks, Canada geese, and tundra swans. A large proportion of the North American population of canvasbacks and redheads also use the open water lake area for staging.

Although most of the waterfowl using Lake St. Clair for staging breed in western North America, waterfowl that breed in parts of southern Ontario also use Lake St. Clair as a staging area (McCullough, 1999). Prince et al. (1992) identified the marshes of Georgian Bay and Saginaw Bay as significant areas of waterfowl production in the Great Lakes with at least 2,100 and 4,400 nesting pairs of dabbling ducks, respectively. The Atlas of the Breeding Birds of Ontario (Cadman et al., 1987; Meredino, McCullough et al., 1995) also reveals large areas of southern Ontario with breeding records for Canada geese, wood ducks, green-winged teal, American black ducks, mallards, blue-winged teal, and mergansers.

Two populations of Canada geese, the Southern James Bay Population (SJBP) and the Mississippi Flyway Giant Population (MFGP), regularly use Lake St. Clair during migration. There has been a significant increase in the size of the SJBP during the last ten years. The MFGP has only been monitored for the last 2 years and the preliminary 1999 estimate was 1,390,200 geese, which is 1.5 percent greater than the 1998 estimate (US Fish and Wildlife Service, 1999). Nelson and Oetting (1998) state that the rapid increase of giant Canada geese in the Mississippi Flyway during the past twenty years far exceeds that in any other flyway.

Canada Geese

The eastern population of tundra swans was estimated at 109,000 individuals, which is 13 percent greater than the 1998 estimate (U.S. Fish and Wildlife Service, 1999). However, no evidence was found to show a trend in the size of this population over the last ten years.

Although waterfowl populations in the Lake St. Clair area reflect the increase in North American waterfowl populations, it has not been determined how the use of Lake St. Clair by staging waterfowl is related to this overall increase.

Staging Waterfowl

Considerable work has been undertaken on postbreeding habitat use by waterfowl since Fredrickson and Drobney's (1979) landmark review revealed the scarcity of such information. Yet two decades later, despite increased research, the use and importance of habitats for waterfowl during migration remains a significant knowledge gap (Williams et al., 1999). Consequently, there is little research to support more than general statements about the effects of the proposed wetland restoration on migrating waterfowl.

The addition of 1,000 acres of wetland to the Lake St. Clair area should have a positive effect on the continental waterfowl population and on regional waterfowl populations.

The addition of 1,000 acres of wetland to the Lake St. Clair area should have a positive, albeit small, effect on the continental waterfowl population and on regional waterfowl populations. The principal benefit of the wetland to waterfowl will be the increase in available area for staging in the Spring and Fall. This additional staging area will primarily benefit dabbling ducks by maintaining or improving the birds fitness during migration.

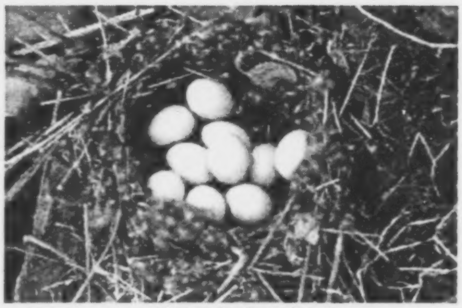
The benefits provided by the restored wetland will be especially valuable during the Spring migration for several reasons:

- Spring migration is more rapid and as a result there is more crowding of available habitat at this time
- The managed drainage network in the area results in very few flooded fields (sheetwater) which restricts waterfowl to natural or managed wetlands
- Waterfowl generally have a greater demand for food (energy) in the Spring in preparation for egg laying
- Waterfowl feeding may be restricted to invertebrates since much of the vegetation has not initiated growth (BELSCWRW, 1999)

Using Canadian Wildlife Service aerial survey records for dyked wetlands along the eastern shore of Lake St. Clair, it is estimated that the restored wetland could provide 318,000 dabbling duck days during Spring and Fall migration (McCullough, 2000). Dabblers other than mallards or black ducks, such as gadwalls, wigeons, shovellers, wood ducks, green-winged teal, and blue-winged teal, would account for approximately 60 percent of wetland use during Spring migration.

Breeding Waterfowl

The principal aim of the restored wetland will be to serve as staging area for waterfowl. However, certain species of ducks will also breed in the new habitat. Therefore, the wetland will have a positive effect by adding to the North American population of waterfowl.



Waterfowl nest

Based on breeding waterfowl surveys conducted by Ducks Unlimited Canada, waterfowl production could be as high as 0.85 ducks per acre, per year (Steele, 2000). If the restored wetland is highly managed, total waterfowl production from this site would be approximately 850 birds, representing about 142 broods. Most of the waterfowl produced would be mallards, with only a few from other dabbler species and diving duck species (i.e. redheads or canvasbacks).

The above estimate assumes that all of the marsh cells will have:

- Similar waterfowl productivity
- Typical fledgling rates
- Adequate management to maintain habitat
- Similar available waterfowl pairs
- Adequate nesting sites/habitat

The first three assumptions will likely be met by the proposed wetland; however the two additional assumptions would require the use of numerous nesting cylinders along with other habitat initiatives and, therefore, are less likely to be met.

The incorporation of additional habitat types into the restoration project, specifically tall grass prairie and wooded swamp may, over time, increase the use of the site by other species (e.g. wood duck, black duck).

6.3 Local Waterfowl Population and Distribution

Background

Lake St. Clair is the second most important waterfowl staging area in Ontario. Between 1968 and 1982 there was a 37 percent increase in waterfowl numbers (from 4,973 to 6,811 individuals) during the Fall staging period along the eastern shore of Lake St. Clair (Dennis and North, 1984). However, not all waterfowl species experienced this increase; black ducks and other dabblers experienced significant decreases in numbers over the same period (36 percent and 73 percent respectively) in the Lake St. Clair marshes. Factors cited for the overall increase include expanding populations of mallards (99 percent increase) and Canada geese (190 percent increase) and the increased use of baited sanctuaries. These baited sanctuaries are responsible for extending the duration of waterfowl use of Lake St. Clair during the southern migration period.

The distribution of staging ducks in the Study Area, as in most other areas, is influenced by three main factors:

- Available habitat and food
- Hunting and other disturbances
- Location of baited sanctuaries

Available Habitat and Food

The availability of natural foods does not assure that waterfowl will be attracted to an area. Wetland foods are only accessible if appropriate water depths are maintained during critical time periods, habitats are protected from disturbance, and habitats that provide protein and energy are close together (Fredrickson and Reid, 1988). Owen (1973 and 1976), for example, states that habitat and food availability are the most important factors influencing geese distribution, while disturbance is the most important factor controlling food and food habitat utilization.

The Study Area currently offers approximately 4,764 acres (1,945 ha) of wetlands. Local habitat and food sources for migrating waterfowl include natural and managed wetlands as well as agricultural fields.

The Lake St. Clair wetlands are particularly important for waterfowl during the Spring migration. As noted previously, the passage of waterfowl in the Spring is much more rapid and the availability of natural wetland foods may be limited. Some waterfowl (e.g. pintails) will feed on invertebrates associated with temporary surface water on agricultural fields (i.e. sheetwater), but, given the extensive drainage network in place, such areas are few in the Study Area.

In the Fall, migrating waterfowl use the wetlands and feed on available plant material. Agricultural lands are not as important for waterfowl as they once were due to the growing use of baited sanctuaries, improved efficiency of farm machinery for harvesting, and changing land use practices. Most of the wetlands managed by hunt clubs in the Study Area use baited sanctuaries to some extent to attract and retain waterfowl within their lands (BELSCWRW, 1999).

Waterfowl Responses to Hunting and Other Disturbances

Hunting can be a major disturbance to migrating and wintering waterfowl (Evenson et al., 1974; Henry, 1980; Jessen, 1981; Heitmeyer, 1985; Tamisier, 1985) and hunting from boats is particularly disturbing (Evenson and Hopkins, Jr., 1973; Joensen and Madsen, 1985). Hunting leads to great wariness in waterfowl, which increases their susceptibility to disturbance from all human activities (Newton and Campbell, 1970; Meltofte, 1982).

Waterfowl tend to spend more time in flight during the hunting season and may change their habitat use, daily time budgets, and food habits in response to human-related disturbance (Heitmeyer, 1985). It is not uncommon for waterfowl to alter their daily activity patterns – feeding at night and spending the day in a refuge during the hunting season (Raveling et al., 1972; Thornburg, 1973; Evenson, 1974; Burton and Hudson, 1978; Owen and Williams, 1976; Maher, 1982; Madsen, 1988). In some instances, waterfowl will permanently or seasonally abandon a traditional migration or wintering area because of hunting pressure, even if food is still plentiful in the shooting zone (Berry, 1939; Owen, 1973; Newton et al., 1973; Madsen, 1988).

Baited Sanctuaries

Baited sanctuaries, which often use corn and other grains, are highly attractive to some waterfowl species during migration. For example, mallards may prefer feeding in baited sanctuaries, versus entirely foraging in natural wetlands, because the sanctuaries minimize overall feeding time and other costs (e.g. exposure to predators and extra energy for flight) (Baldassarre and Bolen, 1994). Baiting can hold birds for longer periods of time in a given area during migration and can attract some waterfowl species to use areas subject to hunting disturbance. Some landowners intentionally flood standing corn crops as a means to attract waterfowl for hunting. Within the Study Area, baited sanctuaries have been established at several locations under the authority of the Migratory Birds Conservation Act. Hunting is prohibited within 400 m of these baited sites, resulting in a 125 acre (51 ha) sanctuary.

However, despite its great attraction for some waterfowl species, baiting has a number of limitations. First, agricultural foods provide waterfowl with a nutritionally incomplete food source (Baldassarre et al., 1983). For example, although corn provides adequate energy (ca. 4.70 kcal/g dry matter), it lacks some essential nutrients that can only be acquired from natural foods in wetlands (Fredrickson and Taylor in Bookhout et al., 1989). Second, baiting is not attractive to many waterfowl species, including gadwall, wigeon, blue-winged teal, ringneck, and wood duck, as they depend almost entirely on natural wetland foods. Third, even for those species attracted by baiting, the degree to which these species will feed on agricultural grains is affected by the abundance and availability of food in natural habitats (Baldassarre and Bolen, 1994).

The use of baited sanctuaries is a valid management tool for the restored habitat but is not seen as a priority. Future use of baited sanctuaries should be coordinated with other marshes and clubs in the area.

Cooperation with other clubs should result in minimal alteration of the local distribution of waterfowl during the hunting season.

Summary

The abundance and distribution of waterfowl in the Study Area are affected by three main factors; the available habitat and food, hunting and other disturbances, and, for some species (e.g. mallards), the location of baited sanctuaries.

Waterfowl present in the Study Area have undoubtedly been affected by the large reduction in wetland area that has occurred around Lake St. Clair; as this reduction resulted in fewer opportunities for waterfowl feeding and resting. The use of baited sanctuaries may compensate somewhat for loss of waterfowl feeding opportunities, but these sanctuaries are limited in terms of the waterfowl species they attract and the nutrition they provide (compared to natural sources).

Further compounding the loss of wetlands for waterfowl in Lake St. Clair has been the continued local hunting pressure and increase in other human disturbances such as boat traffic. These disturbances are important influences affecting the local abundance and distribution of waterfowl in Lake St. Clair. For example, human disturbance is believed to have reduced Fall waterfowl numbers in Lake St. Clair. Jaworski and Raphael (1978) reported that hunting pressure and disturbance by boaters and fishermen force most diving ducks to leave the U.S. waters of Lake St. Clair before food supplies are consumed. Dennis and North (1984) predicted that as hunting pressure increased in the Lake St. Clair area, use by waterfowl would decrease during Fall migration. Also, a shift in daily activity patterns from day feeding to night feeding in response to hunting pressure has been observed in the Study Area (BELSCWRW, 1999).

The restoration project of wetlands in the Study Area would increase opportunities for attracting and retaining additional waterfowl in the Fall, even under existing disturbance pressures.

The restoration of wetlands in the Study Area would increase opportunities for attracting and retaining additional waterfowl in the Fall, even under existing disturbance pressures. Hunting opportunities would not necessarily be compromised since the likely result would be an overall increase in waterfowl using the Study Area. Larger extents of wetland would also benefit waterfowl during Spring migration and provide additional nesting areas.

6.4 Effects of Wetland Restoration

A 1,000 acre restored wetland represents approximately 21 percent of the total wetland area in the Study Area. As previously discussed, this additional wetland area will benefit migrating and, to some extent, breeding waterfowl that use the area by increasing available habitat. It is not known with certainty whether the wetland would simply redistribute waterfowl currently using the area or if it would generate additional waterfowl stopovers. Given the increase in waterfowl numbers in recent years, it is anticipated that additional wetland habitat will increase the number of migrating waterfowl using Lake St. Clair area as a stopover. McCullough (2000) predicts that in the short-term (i.e. 1 to 5 years) the wetland could redistribute birds within the Study Area; however, after five years an increase in dabbler use over the entire Study Area is expected as the wetland becomes established.

The proposed wetland may influence the local distribution of migrating waterfowl. However, waterfowl distribution and use is more likely to be influenced by wetland management policies than by actual location of the restored acres (BELSCWRW, 1999). Hunting will be permitted in some parts of the restored wetland; therefore, hunting pressure in the restored area should have the same effect on waterfowl distribution as local hunt clubs. In addition, since baiting is not anticipated in the proposed wetland, it is unlikely that the waterfowl will shift their distribution from existing hunt club locations.

It is not anticipated that the proposed wetland will affect the local distribution of waterfowl.

Implications of Wetland Location

Large sites afford greater security from disturbance for waterfowl than smaller sites (Newton et al., 1973; Owen and Williams, 1976). This finding suggests that waterfowl may experience increased benefit if the proposed wetland is consolidated with other existing wetlands, rather than being located in isolation. Consolidating blocks of wetlands would also benefit many other organisms, especially those that are not able to travel great distances (see Section 6.5 on biodiversity).

The proposed wetland should not be located in an area with incompatible adjacent land uses (i.e. areas with levels of human activity, such as urban areas). Locating the wetland close to areas of high human disturbance would likely interfere with the function of attracting migrating waterfowl.

Locating the wetland as close to the lake as possible may increase the advantage to migrating waterfowl due to shortened travel distance to and from the lake. Hunting within the wetland may cause waterfowl to seek refuge during the day and then return to feed in the wetland at night when hunting is prohibited. In this case, the lake may function as a diurnal refuge for the waterfowl and its proximity to the wetland would lessen the energy expended by the waterfowl.

Finally, the wetland should be located in an area that ensures adequate quantities of high quality water. Pollution sources, such as runoff from intensively managed agricultural fields, could interfere with the ecological functions within the wetland by increasing turbidity and nutrients. An increase in the latter could lead to eutrophication of the wetland cells and a subsequent decline in some waterfowl plant food and invertebrates.

Implication for Wetland Design

Ducks Unlimited has considerable experience in the design and management of wetlands to serve as waterfowl staging areas (see Mansell et al., 1998). Managed as a waterfowl staging area, the proposed wetland will consist of a number of wetland cells separated by dykes. Water level in each cell can be controlled depending on required habitat conditions. Typically, wetland habitat for staging waterfowl would be composed of about fifty percent emergent marsh and fifty percent open water with floating-leaved emergent or submergent vegetation.

Wetland management includes the raising and lowering of water levels to:

- Ensure the persistence of the wetland conditions
- Control the spread of emergent vegetation (i.e. cattails)
- Control the spread of undesirable plant species (e.g. purple loosestrife)
- Ensure use by waterfowl at the appropriate time in the season
- Maximize wetland productivity
- Maximize benefits to other wetland dependent wildlife

Additional wetland management issues in this particular case include allowing hunting and limiting the use of baited sanctuaries in portions of the wetland.

6.5 Biodiversity

Biodiversity, short for "biological diversity," is a multidimensional and multiscalar concept that can be simply defined as the diversity of life and its processes.

Biodiversity, short for "biological diversity," is a multidimensional and multiscalar concept that can be simply defined as the diversity of life and its processes. Biodiversity includes genes, species, populations, communities, ecosystems, and ecological processes. For the purposes of this report, biodiversity will focus on species, habitat types, and ecological processes.

When attempting to increase biodiversity as an ecosystem management goal, the somewhat conflicting requirements of "generalist" and "specialist" species must be considered. Simply augmenting the number of habitat types present in a certain area can increase biological diversity. If habitat patches are fairly small, this management action will tend to favour generalists at the expense of specialists. Specialists have specific requirements for the size of habitat type, proximity among different habitat types, or special habitat features, whereas generalists are less specific in their needs. Devoting a large area to one particular habitat type will favour specialists of that habitat type but will tend to decrease overall species diversity in that area by eliminating species with other habitat requirements. Therefore, at a site-specific level, augmenting the number of habitat types at the site can increase species diversity. On a landscape scale, biodiversity can be increased by ensuring that some habitat types are large enough to support the specialists or area-dependent species.

Factors to be considered in setting management objectives for biodiversity include:

- Number of habitat types
- Size of the habitat types
- Interspersion between habitat types
- Isolation of habitat types

Each of these factors has been shown to have an influence on the assemblage of organisms that will use the area. For example, the size of individual, contiguous patches of a particular habitat type has a great effect on whether certain birds will use a habitat patch or not. This effect has been shown for forests (e.g. Freemark and Collins, 1992), grasslands (e.g. Samson, 1980), shrublands (e.g. Confer and Knapp, 1981), non-forested wetlands (e.g. Brown and Dinsmore, 1986), and both forested and non-forested wetlands (Mansell et al., 1998). Some species require a shifting mosaic of suitable habitat types. Henslow's sparrows, for example, have very exacting habitat requirements and they will shift from patch to patch of suitable grassland as certain other areas become unsuitable (Askins, 1993). Moreover, it has been shown that these sparrows will not inhabit grasslands smaller than 75 acres (30 ha) (Herkert in Askins, 1993).

The following sections identify the importance of the Lake St. Clair shoreline as an area of biodiversity and discuss the possible effects of the proposed wetland on biodiversity and the implications of wetland location, design, and management on biodiversity.

Background

As previously stated, the Lake St. Clair shoreline has been identified as a Biodiversity Investment Area (BIA), largely due to the large number of rare species found there (Reid and Holland, 1997). The Study Area, including Lake St. Clair, provides habitat for species of plants, amphibians and reptiles, birds, and mammals (see Appendix G). Several of these species, such as the King Rail, Least Bittern, Spotted Turtle and Spiny Softshell Turtle, are rare in Canada and are listed as endangered, threatened, or vulnerable by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

The area also supports a number of vegetation communities, such as cattail marshes, swamps, remnant tall grass prairie, etc. Hundreds of plant species occur in the area; several of which are considered rare in Ontario and/or Canada (e.g. Swamp Rose-mallow-Hibiscus mosheutos, Green Arrow-arum-Peltandra virginica, American Lotus-Nelumbo lutea) (see Appendix G).

Most of the species of fauna and flora as well as the vegetation communities present in the Lake St. Clair area are highly dependent on the direct effect of lake dynamic processes for their continued existence. Similar dynamic water level processes are present within dyked wetlands and, under typical water level management regimes, contribute to wetland biodiversity.

Effects of Wetland Restoration

Although the primary purpose of the restored wetland will be as a feeding and resting area for migrating waterfowl, wetland restoration will also support numerous other plant and animal species. In addition, the incorporation of alternate habitat types in the overall design of the restored wetland project has the potential to significantly augment local biodiversity.

The incorporation of alternate habitat types in the overall design of the restored wetland project has the potential to significantly augment local biodiversity.

The St. Clair NWA serves as an example of species that could be expected at the proposed wetland. Over 200 species of plants and birds have been recorded in the area. Of the birds observed, 50 are confirmed to be breeding onsite. Some of the organisms at the site are considered rare and have been listed by COSEWIC as either endangered, threatened, or vulnerable. Therefore, the proposed wetland restoration project has the potential of increasing the available habitat for species deemed significant because of their rarity in Ontario and Canada – a critical step towards reducing their "at risk" status.

Biodiversity can be further enhanced if additional vegetation types can be restored or combined with the staging area wetlands. Each vegetation type carries its own suite of plants, ecological features and functions, and dependent wildlife species. Forested areas, such as provided by swamps for example, are exceedingly sparse in the Study Area. Provision of a forest stand in the site plan design would benefit a host of organisms that are uncommon in the area simply because of the sparseness of forests locally. Simply planting a few trees will create feeding opportunities for migrating songbirds that otherwise might not use the site.

Figures 6-2 through 6-15 illustrate the total and cumulative number of species of plants, butterflies, amphibians and reptiles, birds, and mammals that could inhabit the existing and possible habitat types proposed for the project. For the purposes of this study, bird species numbers include migrant waterbirds, such as ducks, geese, and shorebirds. The first figure of each pair for the organism groups shows the total number of species that could colonize and inhabit each habitat type. The second figure shows the cumulative species number, i.e. the number of species for each successive habitat type that are not associated with any of the previous habitat types listed. These figures were derived from lists of species developed by members of the Study Team, the Lake St. Clair Technical Committee, the Natural Heritage Information Centre (NHIC), and others (see Appendix G).

The figures show that, although existing agricultural lands and drains provide habitat for a certain suite of species, restoring additional habitat types successively contributes to the species diversity of the area as a whole. The species already associated with the existing agricultural lands and drains in the study area are used as the base case against which to examine potential biodiversity effects of restoring additional habitat types. As a general rule, the greater the number of habitat types the greater the number of species that will be attracted. The restoration of the principal habitat type, shallow marsh, will attract a host of species in addition to migrating waterfowl. Some of the habitat types, although not attractive to migrating waterfowl, will serve to attract large numbers of species, some of which are rare.

The species already associated with the existing agricultural lands and drains in the study area are used as the base case against which to examine potential biodiversity effects of restoring additional habitat types.

Existing agricultural lands and drains in the Study Area have the potential of supporting 270 species of plants, butterflies, amphibians and reptiles, birds, and mammals taken as a group (termed 'total biota' in this report) (Figure 6-2). Although this is a large number of species, many of these species are common throughout southern Ontario. Total biota of existing agricultural fields and drains include 8 rare species (Figure 6-3 and Figure 6-4). Rare species include those that have been given status of threatened, vulnerable, or endangered by COSEWIC, and/or have been given the rank of S1, S2, or S3 by the NHIC.

FIGURE 6-2
NUMBER OF SPECIES LIKELY TO INHABIT EXISTING AND PROPOSED HABITAT TYPES

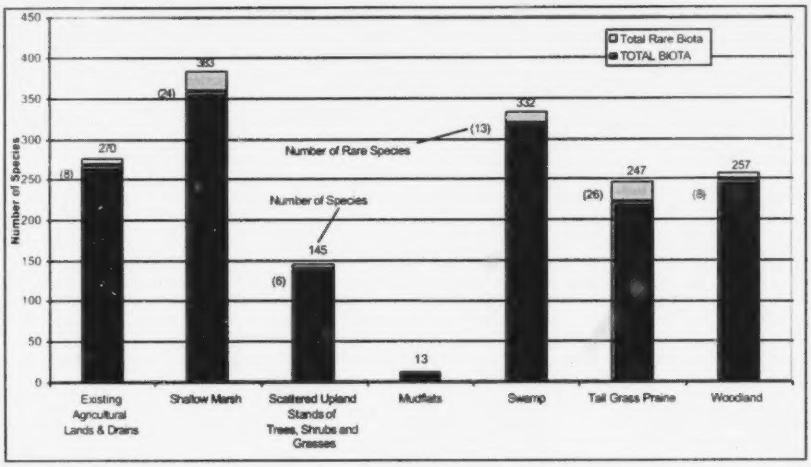


FIGURE 6-3
TOTAL SPECIES OF ANIMALS LIKELY TO INHABIT EXISTING AND PROPOSED HABITAT TYPES

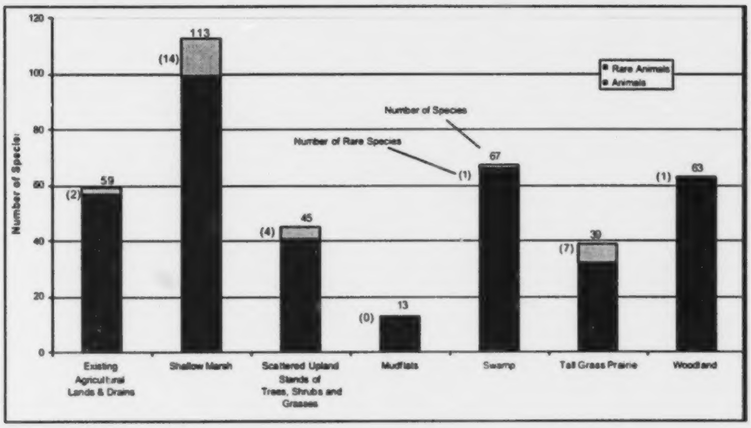
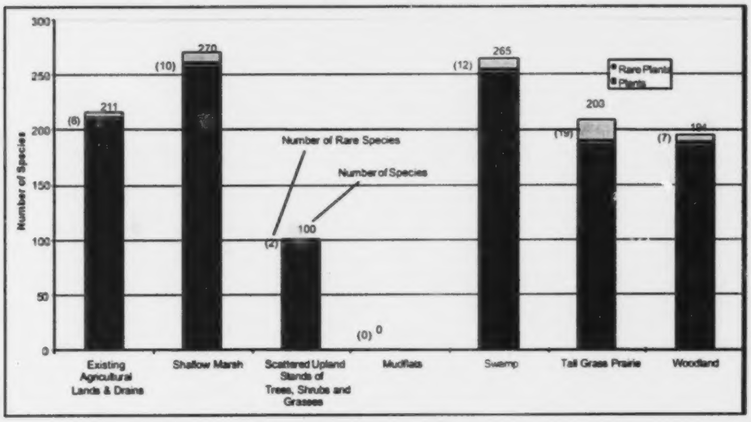


FIGURE 6-4
TOTAL SPECIES OF NATIVE PLANTS LIKELY TO INHABIT EXISTING AND PROPOSED HABITAT TYPES



Of the proposed habitat types to be restored, the greatest number of species is associated with shallow marsh, followed by swamp, woodland, tall grass prairie, upland on the dykes, and mudflats (Figure 6-2). Shallow marsh also accounts for the greatest number of rare species, followed by tall grass prairie, swamp, and uplands on dykes. Shallow marsh contains by far the most species of animals (113), followed by swamp (67), woodland (63), existing agricultural lands and drains (59), the uplands of the dykes (45), tall grass prairie (39), and mudflats (13) (Figure 6-3). Shallow marsh is also expected to contain the most native plant species (270), but the differences between some habitat types are less marked for plants than for animals. For example, existing agricultural lands and drains (211) and swamp (265) have almost the same number of plant species as shallow marsh. Tall grass prairie and uplands have noticeably fewer plant species (108 and 100 species, respectively).

Restoration of all of the proposed habitat types could more than double the total biota in the area to 804 species (Figure 6-5). Of the 534 additional species provided for by the restored habitat types, 135 are animals and 399 are plants (Figure 6-6 and Figure 6-7). Twenty of the additional animal species and 39 of the plant species are considered rare. Of course, each of the various habitat types is associated with a group of species not found in any other habitat type. The shallow marsh and associated upland dykes, which will cover most of the restored area, will account for half (269 or 50 percent) of the new species. Swamps could add 91 (17 percent) additional species to the area and tall grass prairie could add 72 (14 percent). The remaining 102 species (19 percent) could be contributed through upland woodland habitat.

FIGURE 6-5
CUMULATIVE NUMBER OF SPECIES LIKELY TO INHABIT PROPOSED HABITAT TYPES

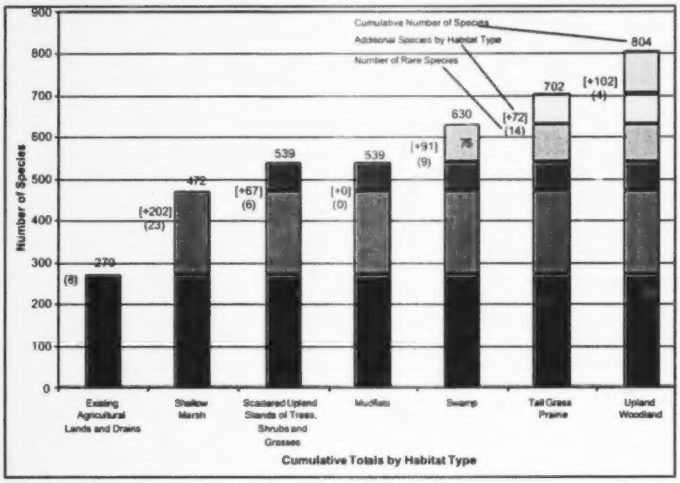


FIGURE 6-6
CUMULATIVE NUMBER OF ANIMAL SPECIES LIKELY TO INHABIT PROPOSED HABITAT TYPES

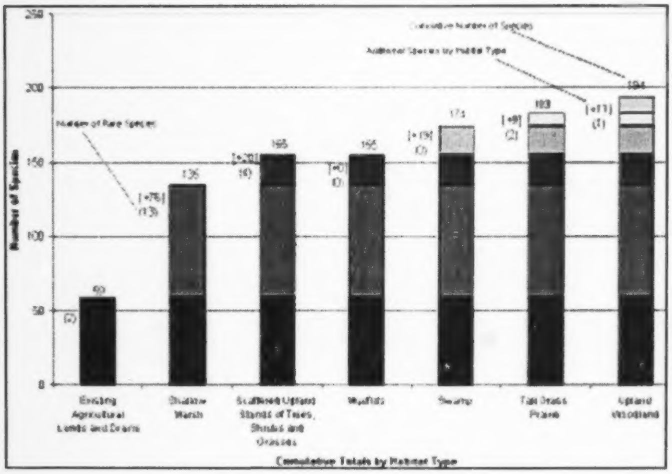
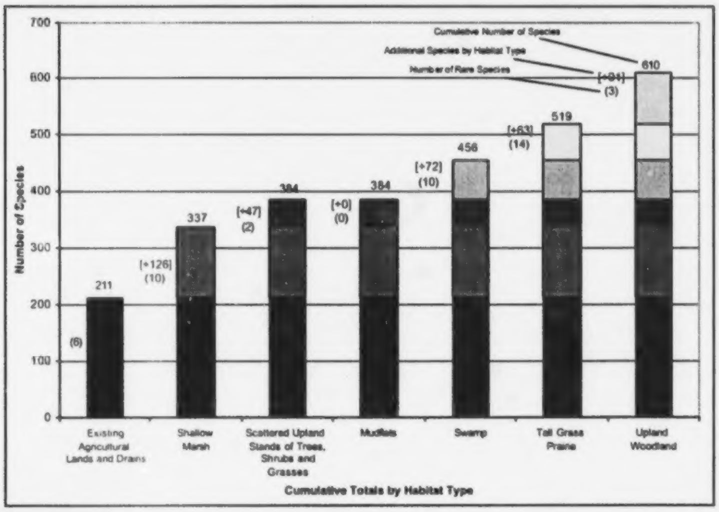


FIGURE 6-7
CUMULATIVE NUMBER OF PLANT SPECIES LIKELY TO INHABIT PROPOSED HABITAT TYPES



Monarch butterfly

The greatest number of butterfly species are anticipated in shallow marsh, followed by the swamps, tall grass prairie, woodland, and existing agricultural lands and drains (scattered upland sites associated with the dykes) (Figure 6-8). The restoration of shallow marsh and the associated dykes will more than double the number of butterfly species in the area, from 11 species to 32 (Figure 6-9). Forested swamps are expected to add only seven new species, while tall grass prairie could provide habitat for three additional species.

FIGURE 6-8
BUTTERFLY SPECIES LIKELY TO INHABIT PROPOSED HABITAT TYPES

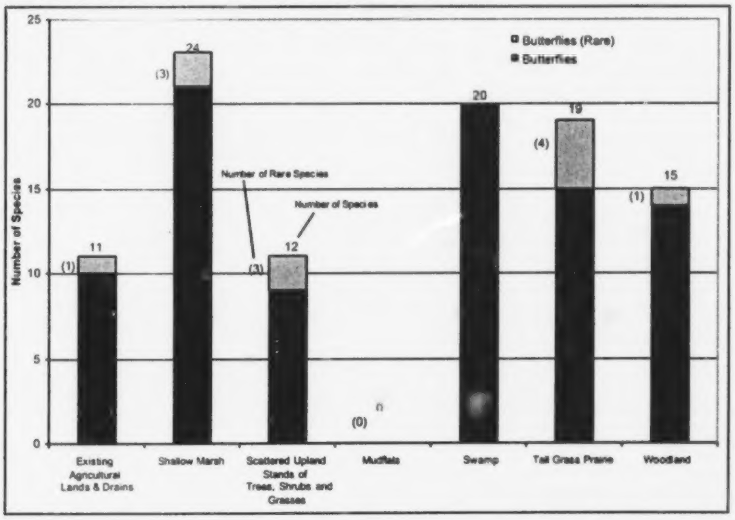
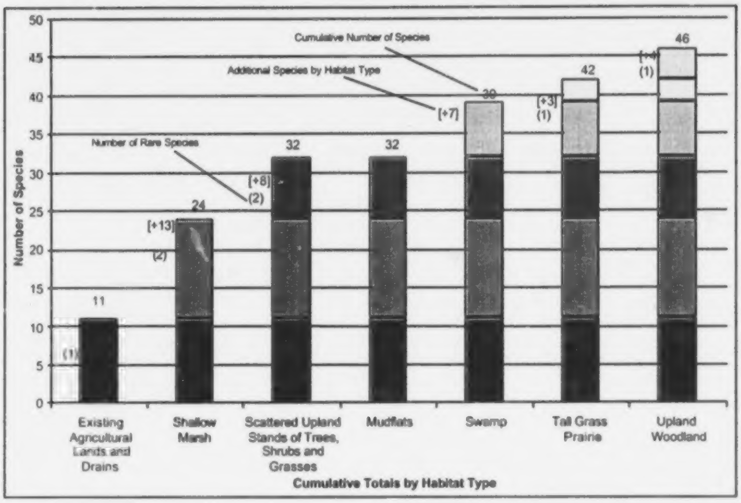


FIGURE 6-9
CUMULATIVE NUMBER OF BUTTERFLY SPECIES LIKELY TO INHABIT EXISTING AND PROPOSED HABITAT TYPES



The greatest number of amphibian and reptile species is anticipated in shallow marsh (15), followed by swamp (11), existing agricultural lands and drains (6), tall grass prairie (5) and upland woodland (5) (Figure 6-10). The restoration of shallow marsh will more than double the number of amphibian and reptile species in the area (Figure 6-11); two of the additional species are considered rare. The addition of further habitat types will add only two new reptile species associated with tall grass prairie, one of which is rare.

Frog

FIGURE 6-10
AMPHIBIANS AND REPTILES LIKELY TO INHABIT THE EXISTING AND PROPOSED HABITAT TYPES

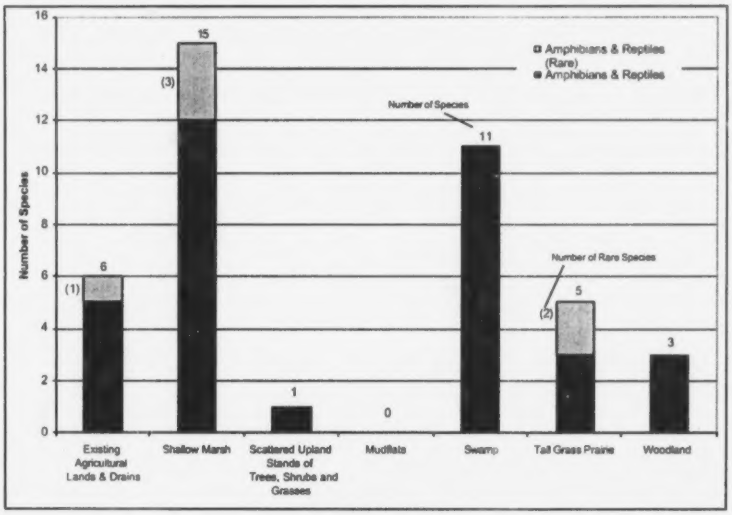
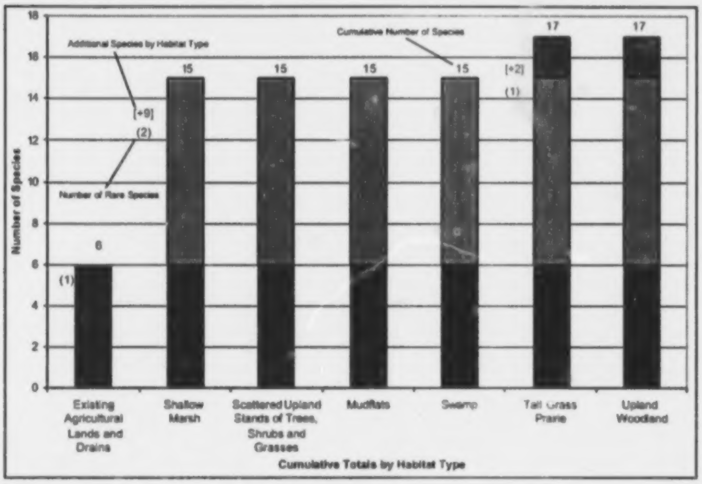


FIGURE 6-11
CUMULATIVE NUMBER OF AMPHIBIAN AND REPTILE SPECIES LIKELY TO INHABIT EXISTING AND PROPOSED HABITAT TYPES



Blue heron

The greatest number of breeding bird species is anticipated in shallow marsh (66), followed by existing agricultural lands and drains (35), woodland (34), uplands associated with the dykes (32), swamp (28) and tall grass prairie (11) (Figure 6-12). Migrant waterfowl species are most numerous in shallow marsh, followed by mudflats and existing agricultural lands and drains. The restoration of shallow marsh and the associated dykes could nearly triple the number of species of breeding birds in the area (Figure 6-13); nine of the additional species are considered rare. The restoration project of additional habitat types will add only a few new species of breeding birds to the area.

FIGURE 6-12
BIRD SPECIES LIKELY TO INHABIT EXISTING AND PROPOSED HABITAT TYPES

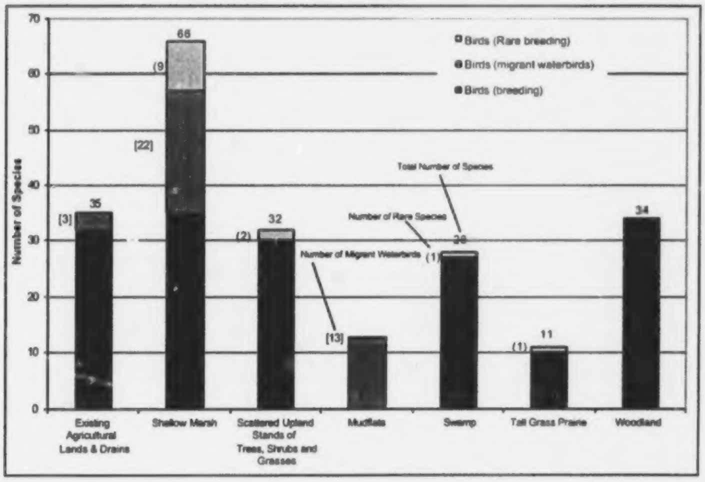
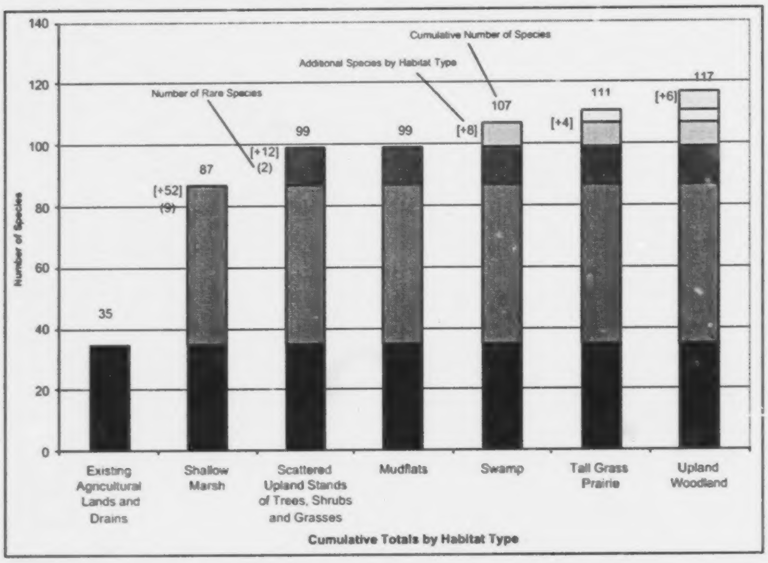


FIGURE 6-13
CUMULATIVE NUMBER OF BIRD SPECIES LIKELY TO INHABIT EXISTING AND PROPOSED HABITAT TYPES



The restoration of shallow marsh and associated dykes is not expected to have a great influence on the number of mammal species that currently inhabit the area (Figure 6-14 and 6-15) and would result in the addition of only two additional mammal species. The restoration of swamp, how ever, would provide an additional four new mammal species.

FIGURE 6-14
MAMMAL SPECIES LIKELY TO INHABIT EXISTING AND PROPOSED HABITAT TYPES

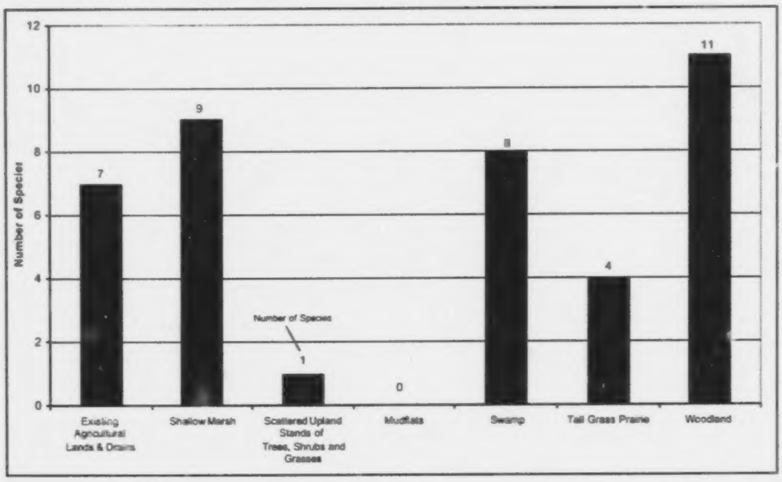
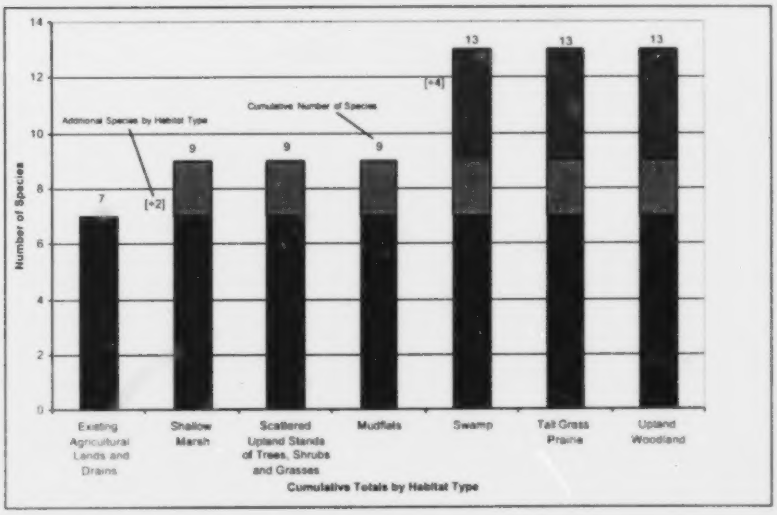


FIGURE 6-15
CUMULATIVE NUMBER OF MAMMAL SPECIES LIKELY TO INHABIT EXISTING AND PROPOSED HABITAT TYPES



In summary, the base case restored wetland (i.e. shallow marsh habitat) has the potential to significantly increase biodiversity in the area; this is a net positive biological effect. The incorporation of ancillary habitat types in the method design has the potential to increase the magnitude of this positive effect by contributing additional species.

The following sections discuss some general implications of wetland location, design and management on biodiversity in general and rare species in particular.

Implications of Wetland Location

The proposed wetland should be located as close as possible to other wetlands if the greatest number of species is to benefit.

The most important factor in wetland location that affects biodiversity is proximity to other existing habitat types. Colonization of the restored wetland by plants and animals depends largely on the proximity of neighbouring populations. While most birds, wind-disseminated plants, and bird-disseminated plants will disperse over considerable distances, many other organisms will be highly dependent on the proximity of the new habitats for colonization. The maintenance of wetland complexes that provide the most heterogeneous array of habitats possible, in terms of both size and types of communities, is likely the best strategy for protecting an array of plants and animals (Baldassarre and Bolen, 1994).

As a general guiding principle, the proposed wetland should be located as close as possible to other wetlands, as well as to other habitat types, if the greatest number of species is to benefit. Factors to be considered include:

- Differences in vagility (i.e. dispersal capability) among species

- Existing barriers to dispersal for certain species (e.g. roadways, intensively cultivated agricultural lands)
- Species requirements for several different habitat types

Locating the proposed wetland close to other habitat types will also take advantage of existing species distribution in those habitat types.

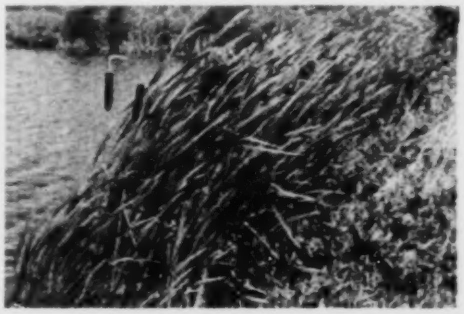
Implications for Wetland Design

Since water management will be a feature of the restored wetland, the greatest influence on biodiversity will likely be the topography of the cells. Bottom contour determines which areas will be covered by water and water depths. In general, two broad habitat types generally associated with the management of a wetland to serve as a staging area for waterfowl are shallow marsh and deep marsh. Mudflat management for shorebirds adds a potentially significant biodiversity benefit. The biodiversity implications for habitat design are discussed below.

Mudflat management for shorebirds adds a potentially significant biodiversity benefit.

Shallow Marsh

In the Great Lakes region, a shallow marsh is best represented by a typical cattail marsh, in which emergent perennials such as cattails and bulrush are dominant. Other common species include submergents such as pondweeds, water milfoil, coontail, and bladderwort. Together these species provide a substantial component of the food resource in foliage, tuber and seeds, as well as harboring macroinvertebrates.



Cattail marsh

In a shallow marsh, emergent vegetation is interspersed with open water. The ratio of vegetation and water can be managed by water level control as well as by control of muskrat populations. Water level control is used to promote growth of specific aquatic plant species, enhance plant community diversity, and improve general plant robustness and vigour. Depending on specific management objectives and site conditions, water levels for shallow marsh areas should remain at less than 60 cm throughout the growing season. A partial Spring drawdown will encourage regrowth of perennials from rootstocks, whereas increased water levels due to Winter and Spring precipitation can be left unchanged to suppress plant community expansion.

Shallow marshes provide the maximum benefit to the greatest number of wetland wildlife species (Weller and Spatcher in Bookhout et al., 1989; Gibbs et al., 1991). Although waterfowl use during fall migration is substantial, Bookhout et al. (1989) report that, as food source, submergent and perennial emergent plants are seldom preferred over seeds of mudflat plants. However, waterfowl requirements for both food and refuge are best provided by shallow marshes. Shallow marshes tend to distribute migratory waterfowl use more effectively than mudflats.

Shallow marshes are an important source of macroinvertebrate food, which is consumed by waterfowl. The greatest numbers of macroinvertebrates occur in areas where open-water habitats of submergent vegetation are interspersed with emergent vegetation (i.e. hemi-marsh) (e.g. Voights, 1976). The large population and diversity of macroinvertebrates found in hemi-marsh wetlands are likely related to the diversity of habitat types rather than to the interspersion of cover and water per se (Murkin et al., 1992). A variety of habitat types will ensure that macroinvertebrates are always abundant somewhere in the wetland throughout the Summer.

Depending on the contour of the bottom of the wetland a margin of "meadow marsh" composed of various forbs and graminoids will also be created between the tall emergent vegetation and the upland vegetation. This margin of meadow marsh can vary in width depending on the bottom contouring, but typically it would be relatively narrow.

Contouring of the wetland bottom in conjunction with water level manipulations can also allow for some areas of the wetland to be above the mean water level, thereby creating pockets of moist upland. Various forbs, shrubs, and trees will colonize these moist upland areas and dykes resulting in linear strips of upland vegetation across the wetland.

Deep marsh

Deep Marsh

Deep marshes are typically composed of open water with a depth greater than 60 cm and scattered clumps of perennial, emergent vegetation. Various species of floating-leaved plants are also common. Compared to mudflats and shallow marshes, deep marshes are generally the least attractive to most waterfowl. A deep marsh with dense growths of such submergent species as wild celery and water milfoil is, however, the most desirable habitat for migrating diving ducks (i.e. canvasbacks and redheads) and some dabbling ducks such as American wigeons, gadwalls, and northern shovellers. Although deep marshes are not specifically planned for the proposed wetland, deep water pockets could contain similar components of deep marshes (i.e. submergent vegetation and floating-leaved emergents).

Mudflat

Mudflats

Mudflats can be managed for either migrating waterfowl or migrating shorebirds. Managed mudflats for waterfowl are characterized by dense stands of annual emergents and high abundance of seed. Managing a portion of a dyked wetland complex for migrating shorebird habitat could be an important goal given the recent decline in the population of these birds (Morrison et al., 1994). However, mudflat or moist-soil management intended to provide waterfowl feeding opportunities will conflict with the goal of providing mudflats for migrating shorebirds due to the timing of drawdowns and partial refillings (Rundle and Fredrickson (1981). Also, Ducks Unlimited Canada has found it impractical to undertake moist-soil management for waterfowl due to the rapid colonization of the managed impoundments by undesirable vegetation (e.g. purple loosestrife) (Steele, personal communication).

Managed shorebird habitat may alleviate the decreasing quality and quantity of natural shorebird habitat (Weber and Haig, 1996). In Ontario, the standard practice by Ducks Unlimited is to manage mudflats for shorebirds by flooding wetland impoundments during the late Fall, Winter, Spring, and early Summer with at least three feet of water and gradually reduce the water level to expose a shallowly sloped shoreline. The initial drawdown is timed to coincide with the arrival of the first wave of migrating shorebirds in mid-Summer. Further incremental drawdowns progressively expose additional shoreline area throughout the shorebird migration period. Incremental drawdowns are important since shorebird predation can cause a significant decline in invertebrate biomass (Weber and Haig, 1996). Management by deep flooding and incremental drawdowns has proven to be the most effective technique to eliminate all vegetation and provide the most suitable feeding habitat for migrating shorebirds. Weber and Haig (1996) report greater use of managed wetlands by migrating shorebirds than natural wetlands.

Other Habitat Types

In general, the greater the diversity of habitat types and habitat features (e.g. snags) the greater the number of species that will utilize the area, to feed, breed, or seek refuge. Two additional habitat types are discussed below – tall grass prairie and thicket/treed swamp. These habitat types are representative of those that were common historically in the Study Area. Swamps are somewhat complementary to the primary purpose of the proposed wetland as a waterfowl staging area since some species will use these habitat types for feeding or breeding. Tall grass prairie is more likely to be used by breeding waterfowl; however, in order to ensure nesting success, the prairie would need to be large enough to disperse predators sufficiently.

In addition to these two habitat types, certain specific habitat features would also help in diversifying the species that use the area. A stand of upland trees, even a single row, will provide habitat for migrating songbirds in Spring and Fall. Woodland is especially rare in the Study Area, which makes any forest stand particularly valuable biologically. Plantings of specific fruit-bearing shrubs and coniferous cover, even simply around the parking area, would provide additional food and cover for migratory species.

Tall grass prairie

Tall Grass Prairie. Tall grass prairie was a dominant vegetation type in the Study Area prior to European colonization. The absence of trees allowed these areas to be rapidly converted to agricultural uses.

Since migrating waterfowl require places to rest and replenish energy and fat, restored prairie is not a wetland management objective for staging waterfowl, as these requirements are met primarily by foods found in wetlands, agricultural fields and/or baited sanctuaries. However, restored tall grass prairie is compatible with waterfowl production and will provide nesting habitat for a number of dabbling duck species.

Depending on the detailed ecosystem management objectives for the proposed area, the size of the prairie is an important factor in determining the species that will inhabit it. If the primary objective is to establish prairie plant species and attract a few generalist grassland birds and invertebrates, then a relatively small area is sufficient (i.e. 10 to 50 ac.). If, however, the objective is to attract specialist grassland birds (e.g. grasshopper sparrow, Henslow's sparrow, upland sandpiper), then larger areas are required (i.e. >75 to 100 ac.) (Herkert and Vickery in Askins, 1993). Finally, if the objective is to provide for more than one or a few breeding pairs of grassland specialist birds and to ensure successful reproduction or to allow for the dynamics of a shifting mosaic of grassland patches, then a very large area is required (i.e. >1,000 ac.) (Askins, 1993; Zimmerman, 1988).

Thicket and/or Treed Swamp. Thicket swamp and treed swamp (composed of deciduous species in this case) are two distinct habitat types but are discussed together here since the former may be replaced by the latter over time. Willows, red-osier dogwood and perhaps other species, such as buttonbush, would be expected to naturally colonize portions of the wetland over time creating thicket swamps. Generally, wetland management favours aquatic plants rather than these shrub colonizers; however, a relatively small area of thicket swamp, can provide habitat for additional bird species, both in migration and during the breeding season. For example, these habitat types are favoured by green herons, alder and willow flycatchers, eastern phoebes, yellow warblers, and common yellowthroats.

Treed swamps may replace thicket swamps if suitable seed sources are available nearby. Silver maples and/or red/green ashes would likely be the dominant tree species expected. A drawback to the establishment of treed swamps is the several decades necessary for maturation. Planting of these species would ensure the development of the treed swamp (assuming the hydrological conditions are met) and would somewhat hasten the development of the swamp.

Treed swamps are used by a number of breeding bird species in Ontario, but a substantial area (i.e. >500 ac.) would be required to attract the very area-sensitive species (e.g. hooded merganser, prothonotary warbler) that breed in swamps. A smaller swamp (e.g. 50 to 100 ac.) would be expected to attract fewer and less area-demanding species (e.g. green heron, wood ducks, northern waterthrush). A forested area of any size, whether upland or lowland, would likely attract large numbers of migrant songbirds since much of the Study Area is currently devoid of trees. Therefore, ecosystem management objectives should not only consider requirements of breeding species but also those of migrants that could be attracted to the site.

A forested area of any size would likely attract large numbers of migrant songbirds.

6.6 Implications for Wetland Management

Water control is the most important wetland management option affecting biodiversity. Proper water level control is essential for maintaining desired vegetation communities within the wetland. While some wetland plant species tolerate prolonged periods of water-saturated soils (i.e. the submergents and floating-leaved emergents), most require a period when soil oxygenation can occur. Water level control is especially important for the management of mudflats to ensure proper timing for mudflat exposure and use by shorebirds, shoreline animals, etc. Too little water for too long will cause upland vegetation to colonize and will disrupt populations of benthic organisms.

Water sampling

Synthesis

Biodiversity will be enhanced at a site-specific scale by simply increasing the number of habitat types present. An increase in habitat types will result in an increase the number of breeding species, and those using the site during migration. The Lake St. Clair shoreline has been cited for the number of rare species present (Reid and Holland, 1997), so consideration of these species in setting objectives for the proposed wetland should be given. Setting ecosystem management objectives to increase the number of "rare" species, however, requires consideration of species requirements for minimum habitat areas, interspersion of different habitat types, and presence of special habitat features.

Based on the brief overview above, the following general guidelines should be considered in setting ecosystem management objectives for increasing biodiversity:

- Objectives for increasing biodiversity need to be compatible with the primary purpose of the wetland restoration project.
- If all of the habitat types are relatively small, habitat generalists will be favoured at the expense of habitat specialists.

- Long-term management for certain habitat specialists must consider the suitability of habitat patches as a shifting mosaic over time. Therefore, area requirements to accommodate the shifting mosaic dynamics must be considerably larger than the area requirements for a certain species to be present there at any given time.
- Proximity of habitat types will tend to increase species diversity since some species (e.g. some raptors) have requirements for more than one habitat type.
- Specific configurations for the interspersion between habitat types is an important requirement for some species (e.g. several duck species).
- Ecological processes responsible for maintaining certain habitat types must be considered and accommodated (e.g. water level dynamics for mudflats, fire for maintenance of prairie, etc.).

The following features should be considered in the planning, design and management of the proposed wetland:

- **Shallow Marsh**
  - Shallow marsh is the primary habitat type for creating staging areas for migrating waterfowl.
  - Large extents of shallow marsh will be beneficial to typical marsh birds as well as rarer species, such as king rail and least bittern.
  - Interspersion of water and emergent vegetation at a ratio of 50:50 should provide habitat for the largest number of species.
  - Meadow marsh components should be expanded to allow the establishment of wide bands of sedges, manna grasses, etc.
  - Components of deep marshes should be included by leaving pools with water between 0.5 to 1 m deep; this will foster the establishment of submergent and floating-leaved emergent vegetation.
- **Dykes**
  - Some trees and shrubs should be permitted to establish to provide habitat for some songbirds.
  - Dykes should be used for nesting by some waterfowl and turtles.
  - If possible, dyke alignment and width should be diversified.
- **Mudflats**
  - A wetland cell or a portion thereof could be managed to provide mudflats for migrating shorebirds; this would require ensuring that mudflats are exposed in late Summer to early Fall as well as in Spring.

- **Thicket Swamp**
  - The swamp could be allowed to naturally develop at the edge of some of the wetland cells.
  - A thicket swamp should attract certain bird species, such as green heron, common snipe, American woodcock, yellow warbler, alder and willow flycatchers and eastern phoebe.
  - Development of thicket swamp should be adjacent to open meadow areas for some species, such as American woodcock.
- **Treed Swamp**
  - The swamp should be of a shape that minimizes edge.
  - Some areas should be planted to hasten the development of a treed swamp. Ideally, the proposed wetland should be located adjacent to existing swamp.
- **Tall Grass Prairie**
  - The area of tall grass prairie could be in the order of 75 to 150 acres (30 to 61 ha) to attract some breeding birds that are grassland specialists as well as maintain a suite of prairie invertebrates.
  - Management interventions, such as burning, should be rotated in 20 to 40 acre (8 to 16 ha) parcels.

6.7 Summary

The proposed wetland will benefit continental and regional waterfowl populations primarily by providing high quality Spring staging habitat for resting and feeding, which will improve the health and increase the chance of survival of migrating waterfowl. The improved health status of birds passing through the St. Clair area will contribute to improved reproductive fitness and will increase the size and stability of continental and regional waterfowl populations. The proposed wetland will also provide some breeding habitat for waterfowl. Since it is managed, the proposed wetland will not be as susceptible to drought conditions as natural wetlands and therefore will increase the reliable supply of good quality wetland habitat.

The abundance and distribution of waterfowl in the Study Area are affected by three main factors; the available habitat and food, hunting and other disturbances, and, for some species (e.g. mallards), the location of baited sanctuaries.

The restoration project of wetlands in the Study Area would increase opportunities for attracting and retaining additional waterfowl in the Fall, even under existing disturbance pressures. Hunting opportunities would not necessarily be compromised since the likely result would be an overall increase in waterfowl using the Study Area. Larger extents of wetland would also benefit waterfowl during Spring migration and provide additional nesting areas.

Large sites also afford greater security from disturbance for waterfowl than smaller sites. This finding suggests that waterfowl may experience increased benefit if the proposed wetland is consolidated with other existing wetlands, rather than being located in isolation. Consolidating blocks of wetlands would also benefit many other organisms, especially those that are not able to travel great distances.

Although the primary purpose of the restored wetland will be as a feeding and resting area for migrating waterfowl, wetland restoration will also support numerous species of plants and animals as well. In addition, the incorporation of alternate habitat types in the overall design of the restored wetland project has the potential to significantly augment local biodiversity. Restoration of all of the proposed habitat types could more than double the total biota in the area to 801 species.

In summary, the restored wetland provides clear biological benefits contributing positively to local waterfowl populations and increasing local biodiversity.

7. Economic Implications of the Proposed Wetland

7.1 Overview

This chapter describes the potential economic impacts of the proposed wetland on the local and regional community. Economic impacts have been measured by estimating the value of two types of change associated with the new wetland:

1. Changes in the value of household incomes
2. Changes in the value of recreational activities

Impacts on household income are changes in cash expenditures in the economy that represent employee and business income. Cash expenditures for goods and services will increase as a result of new expenditures for site construction and operation, as well as new expenditures by recreational users of the wetland; they will decrease due to the reductions in expenditures associated with farm operations that are displaced by the new wetland. Direct, indirect and induced impacts on income are considered.

Direct impacts are the changes in incomes of firms and individuals that are directly engaged in site construction, site operation, supplying recreational goods and services, and farming. Indirect impacts are changes in household and business incomes in those sectors that supply inputs to the sectors that are directly impacted by the restoration project; for example, the firms that sell supplies to displaced farm operations or to site construction contractors. The direct and indirect impacts are changes in the wage, salary and investment income of households. These changes in household income affect household demand for consumer goods and services. Induced economic impacts are changes in incomes in sectors that supply these consumer goods and services.

Changes in the value of recreational activities measure the personal enjoyment derived from the recreational use of the new wetland. Called "user benefits", these values are not represented by cash expenditures in the economy.

7.2 Loss of Agriculture

Approach

While a specific site has not been selected for the new wetland, it is clear that 1,000 acres of land will be acquired for the proposed facility. Intensive cropping is the predominant land use within the study area, with little idle land in evidence and virtually no livestock activity. All of the land to be acquired for the new wetland is therefore assumed to be arable farmland producing cash crops that are representative of the area.

The main agricultural impacts are the loss of farm land, farm operations, and farm production within the acquired site. The specific impacts that are considered and the approach to their analysis are described below in Table 7.1. The principal sources of data for the analysis of these impacts are:

- The 1996 Census of Agriculture (cropping patterns, farm size, gross farm sales)
- Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) reports and statistical data (crop yields by county and year, crop budgets)
- Key informant interviews with local farmers (verification of secondary data on cropping, crop rotations, significance of impacts)
- Windshield survey of crops on August 4, 1999 (cursory count of road side fields by type of crop to evaluate variations in cropping patterns within the study area)
- Information obtained from literature sources and through interviews with agency representatives and others

The main agricultural impacts are the loss of farm land, farm operations, and farm production within the acquired site.

TABLE 7.1
APPROACH TO THE ANALYSIS OF AGRICULTURAL IMPACTS

Type of Impact	Description	Approach
Loss of farm land	The loss of productive farmland is a primary impact of the proposed facility.	Assess total area and farmland quality relative to total area of land in the Dover Community and Municipality of Chatham-Kent.
Loss of farms	The loss of farms in a farm community can have an adverse impact on remaining farms by reducing the opportunity for cooperation and information exchange between farmers and by increasing the possibility of conflict between agricultural and non-agricultural land uses. In extreme cases, losses of family farms can disrupt social fabric and community cohesion.	Assess the likely number of farms lost based on the average farm size and the size of the acquisition area. Compare this to recent trends in the Dover Community and Municipality of Chatham-Kent.
Changes in economic activity	Impacts on economic activity include direct, indirect and induced income effects. Direct effects are changes in gross farm sales. Indirect effects are impacts on the sales of farm sector suppliers and farm labourers who provide inputs to the displaced farms. Induced effects are the impacts on other sectors of the local economy that service affected households and businesses.	Estimate the direct effect by analyzing local cropping patterns, average crop prices and crop yields that are representative of the displaced lands. Estimate indirect and induced effects as a multiple of the direct income effect.

The Loss of Farm Land

The probable immediate impact of the proposed wetland will be the displacement of 1,000 acres of land currently in agricultural production. One thousand acres represents approximately 1.5 percent of the agricultural land in the Dover Community.

Loss of Farms

The average farm size for the Dover Community is 234 acres and the median farm size fell in the range from 130 and 179 acres.[4] An average farm size of 234 acres implies that four to five farm operations could be displaced by the proposed facility. The actual number could be higher or lower depending on a number of site-specific factors, for instance:

- Larger farm operations often use a number of separate parcels of cropland spread over several concessions. The distribution of these parcels reflects the availability of land for sale or rent as the operation expands its land base. The specific spatial distribution of these parcels can also vary annually depending on cropping pattern and land rental agreements. The loss of one parcel of land from such an operation does not mean that the entire operation is displaced.
- Part time, hobby, and retiring farmers often work farms that are smaller than the average farm. The presence of these smaller farms in the acquisition area will likely increase the number of displaced farms.
- Farmers that raise specialty crops, such as tomatoes, may work less land because of the more intensive nature of crop production practices, the higher cost of land that is suitable for the crop, and the higher per acre income from such crops. Acquisition in an area suitable for specialty crops will likely mean the displacement of a greater number of farm operations.

Given the above factors, it is reasonable to assume that up to eight farms will be displaced by the acquisition of 1,000 acres in the study area.

Farm operators interviewed for this study were asked if they were concerned about the potential loss of farm families or farm operations in the study area. None of them expressed any concern about this impact.

Changes in Economic Activity

The census data for 1996 shows that the predominant crops grown in the Dover Community were grain corn, soybeans and winter wheat, comprising just over 90 percent, by area, of all crops grown. Observations made during the windshield survey reveal two distinct cropping patterns in the study area, a grain corn/soybean rotation that includes some winter wheat and a rotation that includes vegetable crops. The corn/bean rotation is located on clay loam soils while vegetables are grown primarily on sandy loam and muck soils found nearer to the lake and to a supply of water for irrigation in the municipal drains. Some vegetable production is taking place on the heavier inland soils. About one half of the vegetable land appeared to be planted in rotation to grain corn or soybeans. These observations were confirmed in discussions with area farmers.

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[4] Based on statistics from the 1996 Census of Agriculture.

A significant acreage of seed corn was also noted in the area. A representative of the Seed Corn Growers Marketing Board in Chatham informed the study team that approximately 7,000 acres of seed corn are grown in the Dover Community annually.

For purposes of estimating gross farm sales, cropping assumptions were based on the 1996 census data and the additional information provided above. Final assumptions are shown in Table 7.2.

TABLE 7.2
CROPPING ASSUMPTIONS FOR THE DOVER COMMUNITY

Type of Crop	Total Crops Grown[a]		Crops on Sand and Muck[b]		Crops on Clay Loam Soil[c]	
	Acres	%	Acres	%	Acres	%
Grain Corn	20,718	(32%)	3,032	(25%)	17,686	(32%)
Seed Corn[d]	7,000	(10%)	-	(0%)	7,000	(13%)
Soy Beans	27,712	(41%)	3,032	(25%)	24,680	(45%)
W. Wheat	5,727	(9%)	-	(0%)	5,727	(10%)
Tomatoes[e]	3,475	(5%)	3,475	(29%)	-	(0%)
Peas-	1,339	(2%)	1,339	(11%)	-	(0%)
Carrots[e]	641	(1%)	641	(5%)	-	(0%)
Sugar Beets	130	(0.2%)	130	(1%)	-	(0%)
Peppers[e]	97	(0.1%)	97	(1%)	-	(0%)
Other	382	(0.6%)	382	(3%)	-	(0%)
Total	**67,221**	**(100%)**	**12,128**	**(100%)**	**55,093**	**(100%)**

[a] 1996 Agricultural Census Data for the Dover Community
[b] All vegetables are assumed to be grown in a 4-year rotation that includes 2 years in soy beans and grain corn
[c] Grain and bean crops are assumed to be grown on clay loam soils
[d] Seed corn acreage from the Seed Corn Growers Marketing Board (All seed corn is assumed to be grown on clay loam soils)
[e] For processing rather than fresh produce

Crop budget data for 1999 were obtained from OMAFRA. These data were adjusted using information from local farmers. Final yield, price and cost assumptions for the principal crops in the study area are provided in Table 7.3. Using the crop proportions for the total study area from Table 7.3, the weighted average values for gross farm sales, operating costs and net farm sales per acre were $660, $299 and $361, respectively. Crop production operating costs do not include the cost of land or general overhead costs. These costs are estimated to represent 31.4 percent of total costs based on 1996 census data. Total crop production costs per acre are therefore $435 and net farm income is $225. These are average figures for the study area. Values for a specific farm can vary significantly from these averages.

TABLE 7.3
ESTIMATES OF GROSS AND NET FARM SALES

Crop	Yield (bushels/ac)	Price (bushels/ac)	Gross Sales ($/ac)	Operating Cost ($/ac)	Net Sales ($/ac)[a]
Grain Corn[b]	150 bu/ac	$3.00/bu	$450	$267	$183
Seed Corn[c]	Not applicable	Not applicable	$800	$114	$686
Soy Beans[b]	50 bu/ac	$7.00/bu	$350	$171	$179
Wheat	66 bu/ac	$4.00/bu	$264	$160	$104
Tomato[b,d]	70,000 lb/ac	$0.06/lb	$4,200	$1,879	$2,321
Peas[b,d]	3,400 lb/ac	$0.13/lb	$432	$201	$231
Carrots[b,d]	50,000 lb/ac	$0.05/lb	$2,500	$943	$1,557
Sugar Beets	25 tons/ac	$55.80/ton	$1,395	$734	$661
Peppers[b,d]	24,000 lb/ac	$0.15/lb	$3,600	$1,820	$1,780

[a] Does not include the cost of land or general farm overheads
[b] Based on Seed Corn Growers Marketing Board
[c] OMAFRA price and yield figures adjusted to reflect local experience (see Appendix H for details)
[d] Crops are for processing rather than fresh produce

As a check on the adjustments that were made, the weighted average values of gross farm sales and total crop production costs reported above were compared to estimates of these values based on the 1996 census data. The average value for gross farm sales, at $660 per acre, was very close to the estimate of gross farm sales made using 1996 census data for the Dover Community, which was $664 per acre. The average crop production cost, at $435 per acre, was only eight percent below the census-based estimate of $472 per acre. These comparisons indicate that the estimated crop sale and cost values are realistic for the study area.

Estimates were then made of the per acre value of gross farm sales, costs and net farm income from clay loam soils used for corn/bean rotations and from sandy and muck soils used for vegetables. These estimates used the crop proportions provided in Table 7.2. The resulting estimates are provided in Table 7.4 below.

TABLE 7.4
GROSS FARM SALES AND FARM INCOME BY CROPPING SYSTEM

Type of Rotation	Gross Farm Sales	Operating Cost	Net farm Sales	Overhead Costs	Net Farm Income
Corn/bean rotation ($/ac)	430	190	240	90	150
Vegetable crop rotation ($/ac)	1,700	780	930	360	570

The displacement of 1,000 acres of agricultural land implies a total annual loss in gross farm sales of $430,000 for a corn/bean rotation or $1,700,000 for a vegetable rotation. The corresponding losses in net farm income are $149,000 and $571,000, respectively. Depending on the proportion of cropping systems that are displaced, the actual losses will lie between these limits. This proportion, in turn, depends on the response of farmers to the loss of land. The lower values are the appropriate measures of loss if the wetland is built further inland in clay/loam soils, since this will displace a corn bean rotation.

If the proposed wetland is built on the sand/muck soils nearer the Lake, then vegetable rotations will be displaced. However, the displacement of vegetable crops may be temporary given the value of these crops. Vegetable growers who lose access to cropland at the site of the wetland will likely shift some of their production to alternative lands that are currently under a corn/soy bean rotation. There is evidence supporting this rotation with tomato production in the area; tomatoes are grown along Highway 40 well away from the Lake. Assuming that seventy percent of the vegetable production is relocated to corn/bean land, then the net loss of vegetable crops is 300 acres and there is a corresponding loss of 700 acres of corn/bean crops, which are displaced by vegetables. Under this scenario, the annual loss of gross farm sales will be about $800,000 and the loss of net farm income about $300,000. This loss is the direct effect of displacing the cropland.

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The Sale of Farm Land and New Household Income

The cost of site land is expected to range from $3.7 to $4.5 million. This money is expected to go to farm families and to be used by these families to create annuity funds for retirement. Proceeds from the resulting retirement funds represent new household income amounting to $329,000 annually. Expenditures from this retirement income will, in part, offset the adverse economic impact of the loss of farm income discussed above.

7.3 Creation of New Opportunities for Recreation

The restoration project of wetland habitat has the potential to provide for additional recreational opportunities; especially birding and nature viewing, and hunting.

Birding and Nature Viewing Activity

Several factors will determine the level of site visitation by birders and nature viewers. Perhaps the most important will be the presence of flora, fauna and ecosystems of interest to the naturalist. The proposed basic wetland design alone will draw visitors, but incremental increases in biodiversity through the creation of additional habitat (e.g. mud flats to attract shore birds or grasslands) will likely increase visitation. As a benchmark, it is interesting to note that the St. Clair National Wildlife Area, which does little advertising and offers only wetlands and limited facilities for visitors, attracted over 2,000 visitors in 1998. Half of these visitors came in May for the spring migration. A comparable visitation rate can be expected at the new wetland if it features only marsh habitats. If a concerted effort is made to build and promote a facility that offers a more varied experience to the visiting public, then visitation rates could be increased substantially. For instance, the Pickerel Creek Wildlife Area in Ohio and Tiny Marsh in Ontario, which are similar in scale to the proposed wetland, attract around 10,000 visitors for nature viewing each year (see Section 5).

The restoration project of wetland habitat has the potential to provide for additional recreational opportunities; especially birding and nature viewing, and hunting.

At the other end of the scale, parks like those at Pelee and Rondeau attract tens of thousands of visitors just during the peak migration period in May. The proposed facility is ideally located to attract overflow visitors from Pelee and Rondeau, for instance by sponsoring a birding festival in May. Smaller birding festivals can readily attract several hundred to a thousand visitors (see Table 7.5). Effective promotion using tools like a web site; listings in the Directory of Birding and Nature Festivals (National Fish and Wildlife Foundation); the magazine, Seasons, published by the FON; and regional tourist brochures can boost visitation to several thousand.

The proposed facility is ideally located to attract overflow visitors from Pelee and Rondeau.

For purposes of the analysis, three levels of visitation are assumed for the project. A rate of 2,000 visitors per year is assumed for a basic wetland site with limited visitor facilities. A rate of 5,000 visitors per year is assumed for a site featuring a more diverse mix of habitats, but the same facilities for visitors. A rate of 10,000 visitors per year is assumed for a site featuring a more diverse mix of habitats, facilities, and site design features that cater to visitors with an interest in nature viewing and related recreational activities.

TABLE 7.5
DESCRIPTION OF BIRD FESTIVALS

Festival Location	Duration	Description	Activities	Fees	Total Visitation
MacGregor Point Provincial Park	10 days	Spring festival for birds calling on the nest in a wooded shoreline corridor	Interpretive tours, display tent, birding challenge, nature car rally	$10 for 10 days or $5 per day	1,000 persons in 1999, about 500 in 1998
Perth Wildlife Reserve	1 day	Fall waterfowl migration festival	Nature walks, arts and crafts, bird carving	$3 per day	300 persons in 1997, 400 in '98, 200 in '99
Point Pelee National Park	1 month (May)	Migration festival, corporate sponsors	Special speakers, guided hikes, workshops, book signings, artist workshops, food fair	$3 park entry fee, $5 for hikes, other events are free	60,000 to 80,000 gate visits in May by 20,000 persons (i.e. multiple visits per person)
Presqu'ile Provincial Park	4 days	Early spring migration festival	Interpretive events, carving display, food court, tea room	$5 park entry fee	9,000 people
Prince Edward County	N/D	Spread across P.E. Co., most activity at P.E Point Conservation Area	Speakers, workshops, guided hikes	No fees	300-400 persons in 1998, 500-600 in 1999
Rondeau Provincial Park	2 months (March/May)	Migration festivals	Guided hikes, interpretive centre	N/D	About 15,000 visits in May

N/D – No data

Source: Empirical data collection via personal interview

Hunting Activity

Information on local hunting activity was obtained from interviews with local residents involved in hunting, including hunt club operators/managers. Controlled hunts occur within private hunt clubs that occupy many of the existing wetlands along Lake St Clair. Areas for public access hunting include open water along the shore and littoral wetlands north of Mitchell's Bay. However, both private and public hunting areas are congested. In addition, although hunting was once common on corn and grain fields following the harvest, this opportunity has been lost due to the efficiency of modern combines, which leave behind very little grain to attract waterfowl. The local consensus is that there are too few sites to satisfy local demand for hunting; therefore, the proposed wetland is welcomed as a development that will help meet this demand.

The local consensus is that there are too few sites to satisfy local demand for hunting; therefore, the proposed wetland is welcomed as a development that will help meet this demand.

Data on hunting at several managed sites are shown in Table 7.6. Hunting levels at higher quality sites are about 0.6 hunter days per acre of wetland or less. More congested sites have hunting frequencies of about 1 day per acre. Factors that determine the level of hunting are the number of blinds or stakes, the number of hunt days per week, and the level of utilization of the blinds.

The following assumptions are made for the proposed EHJV wetland:

- One half of the site (500 acres) would be hunted
- Eight blinds or 63 acres per blind
- Six hunts per week as follows: Monday evening, Tuesday morning, Wednesday evening, Thursday morning, Friday evening, Saturday morning
- 40 percent to 50 percent capacity utilization over the season at 2 hunters per blind
- Seventy hunting days per season

These assumptions imply an average of about 500 hunter days per season.

Nature Viewing and Hunting Expenditures

The potential returns from nature viewing and hunting of waterfowl can be considerable (Keith, 1964). For example, in 1992, about 6,000 birders visited High Island, Texas; they spent $4.4 million (1992 US$2.5 million) in the community, and generated gross regional sales of about $11 million (1992 US$6 million, Eubanks et al., 1993). A study on the Seventh Annual Hummer/Bird Celebration in Texas in 1995 revealed that non-resident visitors contributed $4 million (1995 US$2.5 million) in total gross sales to the local economy (Kim et al., 1998).

TABLE 7.6
ACTIVITY AT MANAGED HUNTING OPERATIONS

	Hullett Wildlife Area	Rondeau Provincial Park	Point Pelee National Park (prior to 1989)	4 Private Hunt Clubs on Lake St Clair
Area Hunted	2,000 acres (809 ha) with 300 set aside for limited hunting	Zone A - 1,000 acres of wetland, W side; Zone B – open water hunting from blinds on the NE shore	2,400 acres	90 acres to 2,800 acres
Baiting	Yes	No	No	Yes
Fees	Season membership ($25). Daily hunt is free except in limited hunt area where charge is $60/day	$7.50 park entry fee + : Zone A - $10/person or $108/season; Zone B - $20/season + $10/blind	Park entry fee plus $7 per day permit fee ($9 in 1999 dollars)	US$200 to $600+ per person per day (includes lodging); no daily fees at member owned camps
Hunt Days	6 days/wk at free stakes, 1 day/wk in limited hunt area; 2 persons/stake	Monday, Wednesday, Friday, Saturday; 2 persons/blind	Wednesday, Thursday, Friday, Saturday; 2 persons/stake	Varies, all camps provide rest days for the birds through the week
Blinds and Stakes	50 stakes, no blinds; about 200 m minimum separation between stakes	Zone A – 30 blinds Zone B – no limit but guidelines regarding separation of blinds	30 stakes, each with access to 40 acres (25 acres open water); minimum 240 m separation between stakes	Varies
Hunter Days	About 2,000 hunter days per season; 100% use in 1^{st} week, less than 20% use thereafter	1,300 hunter days in 1998 in Zone A; 30% use of blinds over the season	970 hunter days (5 year average); 100% use on open day, 34% use over the season	Varies, most operate at or near capacity
Other Features	Draw for stakes on open day, 1^{st} come 1^{st} serve thereafter	Sanctuaries maintained near both zones, blinds distributed by draw	Sanctuary pond, blinds distributed by daily lottery, pre-registration used for the open day lottery	Hunting from blinds, boats or fields, dogs and guides provided
Hunting Intensity	40 acres per stake, 1 hunter day per acre	67 acres per blind, 1.3 hunter days per acre	80 acres per stake, 0.4 hunter days per acre	50 to 280 acres per blind, 0.01 to 1.1 hunter days per acre

Source: Comparative site data (Section 5) and personal interviews.

The most comprehensive studies of hunting and nature viewing are provided by the 1996 Survey on the Importance of Nature to Canadians (DuWors et al., 1999) and the 1996 National Survey of Fishing, Hunting, and Wildlife Associated Recreation (U.S. Fish and Wildlife Service and Bureau of the Census, 1999). Specific data have been published from the most recent surveys on trip and equipment expenditures specifically for migratory bird hunting and wildlife watching (Tables 7.7 and 7.8).

TABLE 7.7
CANADIAN AND U.S. PARTICIPATION IN HUNTING AND WILDLIFE-WATCHING

	Canada[a]		U.S.	
	1991	1996	1991	1996
Hunting				
Hunters (million)	1.5	1.2	14.1	14.0
Hunting days (million)	24.3	12.4	236	257
Expenditures (billion $)	Cdn $1.2	Cdn $0.8	US $12.3	US $20.6
Wildlife-Watching				
Participants (million)	3.9[b]	4.4	76.1[b]	62.9
Expenditures (billion $)	Cdn $2.4[b]	Cdn 1.3[c]	US $17.1[b,d]	US $26.1d

[a] Due to the manner in which activities are calculated, comparisons between surveys should not be made.
[b] Participants and expenditures are for primary non-consumptive trips defined as a trip or outing taken for the primary purpose of encountering wildlife to watch, feed, study, or photograph them
[c] Expenditures in Canada (1996) are for main and secondary activities combined
[d] Expenditures include trip and equipment related expenditures only

Sources: DuWors et al. (1999, 2000); Filion et al. (1989, 1993, 1994); U.S. Fish and Wildlife Service and Bureau of the Census (1999)

TABLE 7.8
EXPENDITURES ON HUNTING AND WILDLIFE WATCHING ACTIVITIES, 1996

Expenditure Item	Wildlife Watching ($/user day)	Migratory Bird Hunting[a] ($/user day)
Total, all items	$167	$78
Total trip-related	$53	$35
Food and lodging	$30	$11
Transportation	$18	$11
Guide fees	$2	$6
Public land use fees	$2	-
Private land use fees	-	$3
Hunting equipment	not applicable	-

[a] Includes ducks, geese, and doves

Source: U.S. Fish and Wildlife Service and Bureau of the Census (1999)

Kreutzwiser (1981) obtained data from 703 users of Long Point marsh on Lake Erie (Table 7.9). Waterfowl hunters were found to spend $137 per party, of which $65 was spent locally. The mean user party size for the hunters was 2.0. Nature viewers spending amounted to $38 per user party, of which $18 was spent locally. The mean user party size for nature viewers was 2.8. The proportions of total trip expenditures spent locally amount to 47.2 percent for waterfowl hunters and 46.6 percent for nature viewing.

TABLE 7.9
EXPENDITURES OF RECREATIONAL USER-PARTIES PER VISIT (CDN $1999)

	Nature Viewers	Fishermen	Waterfowl Hunters	Secondary Users
Travel	$21	$26	$33	$43
Accommodation	$3	$11	$11	$44
Food and drink	$11	$20	$51	$96
Other	$3	$17	$43	$31
Total	**$38**	**$74**	**$137**	**$213**
Local spending	$18	$35	$65	$106
Mean party size	2.8	2.8	2.0	3.3

Calculated and abridged from Kreutzwiser (1981)

An economic assessment of birding at Point Pelee National Park was reported by Hvenegaard et al. (1989). Interviews with birders were conducted onsite in 1987. Key findings of the study are as follows:

- 48.4 percent of respondents came from the U.S. and 2.8 percent were international visitors
- The average one way travel distance of North American visitors was 513 km
- Twenty percent were first-time visitors, but 42 percent had visited at least five times
- Visits during May accounted for 43.5 percent of birders' visits
- 96 percent indicated that visiting the park was the primary intent of the trip
- Visitors spent an average of 3.4 days birding in the area
- The average birder spent $306 (1987, $224) per trip or $90 per day (1987, $66), these amounts include equipment expenditures
- Local expenditures were mainly for food at restaurants and grocery stores (36.7 percent of total expenditures) and accommodations (38.4 percent), these amounted to $172 per trip (1987, $126) or $51 per day (1987, $37)

The proposed EHJV wetland will not resemble Point Pelee, which is one of the top ten birding attractions in North America. Hence, the observations of Hvenegaard et al. (1989) are not directly applicable to the study site. However, as one of a number of stops on a birding circuit focussed on Point Pelee and Rondeau parks, the area could generate considerable interest among birders.

Eliot and Mulamoottil (1992) used 1986 data to estimate the economic value of hunting on Walpole Island in Lake St. Clair. They used permit and hunt-club lease data and other data to estimate total economic value. Of the 2,750 acres of wetlands some 1,800 acres were leased, producing revenues of almost $370,000 (1986, $260,000). With permits costing $25 per day and $200 per season (except for hunt club members) and 5,777 duck hunts, additional revenue of $200,000 (1986, $140,000) was realized (Table 7.10).

TABLE 7.10
REVENUES FROM DUCK HUNTING AT WALPOLE ISLAND (CDN $1999)

	Total Revenue	Local Revenue/Hunt
Duck Hunting Permit Sales	$199,700	$35
Plucking and Cleaning	$55,200	$10
Guiding Fees	$765,000	$132
Total	**$1,019,900**	**$177**

Calculated from Eliot and Mulamoottil (1992) (excluding hunt club members)

Eliot and Mulamoottil do not assess local expenditures other than those made for services at the hunt clubs. These expenditures are considerably larger than the total hunting expenditures reported in Table 7.10 above. For migratory bird hunting in the U.S., they amounted to $60 per day in 1991 (1991US$33, U.S. Fish and Wildlife Service and Bureau of the Census, 1993) and $78 in 1996 (1996US$49). This was also evident at hunt clubs on Lake St Clair south of Walpole Island where daily fees for guided hunts range from $300 to $600 or more (including accommodation). Based on this evidence, expenditures at hunt clubs are not representative of the typical expenditures for waterfowl hunting in the public access areas such as the proposed EHJV wetland.

Average hunting expenditures reported in Table 7.8 are $78 per person, per day, while Table 7.9 gives a figure of $137 for a party of two or $69 per person, per day. These estimates are a useful guide but they are probably low for the proposed facility. They do not account for proposed hunting fees of $50 per day at the facility and they do not reflect new hunting regulations that have increased the cost of shells. An analysis of typical expenditures associated with waterfowl hunting was therefore completed based on research data presented above as well as information provided by local hunt camp and outfitter operators. The results of this analysis, summarized in Table 7.11, suggest that average expenditures per hunter day are about $120. Given an estimated 500 hunter days per season, the total annual expenditure associated with the proposed wetland would therefore be approximately $60,000.

TABLE 7.11
ESTIMATION OF LOCAL HUNTING EXPENDITURES

Item	Unit cost	Same Day	Over Night	Average[1]
Duration (days)		1	2	1.5
Distance Travelled, one way (km)		50	200	125
Transportation	$0.30/km	$30	$120	$75
Accommodation	$40/day	$0	$40	$20
Food	$45/day	$23	$45	$34
Supplies	$40/day	$30	$60	$45
Site fees	$50/hunt	$50	$100	$75
Total trip Expenditure		**$133**	**$365**	**$249**
Expenditure in Canada		$103	$275	$189
Expenditure in Canada/day[2]		$103	$138	$120

Note: [1] Assumes 50/50 split between same day and overnight trips
[2] Assumes 50 percent of hunters are from the US and buy supplies and gas in the US

Estimates reported above of expenditures per user-day for nature viewing are:

• U.S. FWS (1999)	$53	
• Kreutzwiser (1981)	$14	[=($38/day/party) / (2.8 persons/party)]
• Hvenegaard et al., (1989)	$51	(local expenditures including most equipment costs)
• DuWors et al., (2000) – Canada	$17	
• DuWors et al., (2000) – Ontario	$16	

It is difficult to compare these alternative estimates given differences in survey dates and methods. Kreutzwiser's value seems low in relation to prevailing costs for fuel and accommodations. The estimates of U.S. FWS and Hvenegaard et al., at about $50, are very similar. It is unlikely that this level of expenditure would be associated with a visit to the proposed wetland since many birders will visit the site as part of the Pelee-Rondeau circuit. It is realistic to assume that nature viewers visiting the site will spend a portion of the daily expenditure amount reported by U.S. FWS and by Hvenegaard. An expenditure of $25 per user day is therefore assumed for this site.

A visitation rate of 2,000 nature viewers per year for the first scenario, a basic wetland site, would produce expenditures of approximately $50,000. For the second scenario involving diverse habitats but no facilities for visitors and generating a visitation rate of 5,000 per year, annual expenditures are estimated at $125,000. With the third scenario of a diverse mix of habitats and facilities catering to visitors generating a visitation rate of 10,000 per year, annual expenditures are estimated at $250,000.

The expenditures associated with general recreation activity are assumed to be $15 per person per day. This includes the $5 per day entry fee. Total annual expenditures associated with 4,000 days of general recreation are therefore $60,000.

7.4 Impact on Existing Hunt Clubs

Existing hunt clubs could be impacted by the new wetland if it results in competition for hunters and/or competition for waterfowl. Competition for hunters is not expected to occur. The existing hunt clubs provide a higher cost hunting experience, featuring guiding and related services, that caters primarily to U.S. hunters. The new wetland will provide lower cost hunting opportunities to mostly resident hunters and will not provide a service that compares to that of the existing camps. Therefore, it will not compete in the same market for high cost hunting experiences.

The degree to which the new wetland competes for waterfowl with the wetlands used by the existing hunt clubs will depend on a number of factors that affect the local behaviour of the birds, for example:

- Ducks are attracted to readily available supplies of food (natural supplies or bait)
- Ducks will avoid any disturbance (hunting, boats, human traffic)
- Sanctuaries may draw ducks from hunted areas
- Nocturnal feeding patterns will develop if day time hunting pressure is too great
- Disturbances will drive ducks into sanctuaries and/or open water areas
- Ducks will stay in the region for a longer period of time if there is more habitat

Since the proposed wetland will be hunted and will have a beneficial impact on local bird populations, impacts on existing hunt clubs are expected to be negligible.

Baiting has had a major impact on local bird behaviour, even with the hunting pressure around baits, since birds do not need to travel as far or work as hard for food. Current waterfowl populations benefit from bait to build energy reserves for migration. Because of the attraction of bait, baiting is regulated; a permit must be obtained before a bait is set and no hunting is allowed within 400 m of the bait.

The greatest impact on existing hunt clubs will occur if the new wetland is located closer to existing clubs, entirely at the north or the south end of the study area. Impacts are minimized (or equalized) if the new wetland is split into two areas (one north, one south), if local bird populations increase because of the wetland, and if the wetland is hunted.

However, location is not as important as management practices on the site. Since the proposed wetland will be hunted and will have a beneficial impact on local bird populations, impacts on existing hunt clubs are expected to be negligible.

7.5 User Values

The use value of opportunities for recreation created at the new wetland has nothing to do with income or profit earned locally as a result of recreation expenditures. Nor can it be determined by looking at expenditure levels. The relevant measure of this value reflects the non-monetary benefit of recreation to individuals and corresponds to their sense of well being or happiness. Even though this type benefit is non-monetary, methods exist to assign a dollar value to it. Because visitors are only willing to spend a finite amount for the benefits that can be obtained at any given site, "willingness to pay" (WTP) for those benefits is the basis for measuring the value of enjoyment provided by recreation activities.

Students visiting wetlands

A large number of studies were reviewed in the process of determining appropriate WTP values for waterfowl hunting, nature appreciation, and general recreation. These are summarized in Appendix I, in which an assessment is made of the applicability of findings from each study for the current analysis.

Reported WTP values were adjusted for inflation to 1999 Canadian prices and further adjustments were made where possible so that these values reflect conditions in the proposed wetland. The most realistic WTP values for hunting were in the $50 to $60 range—we assume $55. Available information for other types of outdoor recreation support WTP values of $25/day for birding and $14/day for general outdoor recreation. Total annual WTP values for the proposed site are shown in Table 7.12.

TABLE 7.12
WTP VALUE OF RECREATION ACTIVITY

Type Of Use		Value/Day	Total Days	Total Annual Value
Waterfowl Hunting		$55	500	$27,500
Birding	Low	$25	2,000	$50,000
Birding	Medium	$25	5,000	$125,000
Birding	High	$25	10,000	$250,000
General		$14	4,000	$56,000
Totals	Low		6,500	$133,500
	Medium		9,500	$208,500
	High		14,500	$333,500

Based on the willingness to pay approach, user values are expected to be approximately $55/day for hunting, $25/day for birding and $14/day for general recreation. Using these figures, the restored wetland is expected to generate between $133,000 and $333,000 each year, a value attributable to the enjoyment provided by new recreational activities.

The restored wetland is expected to generate between $133,000 and $333,000 each year, a value attributable to the enjoyment provided by new recreational activities.

7.6 Summary of Impact on the Local Economy

The local economy will change as a result of losses in agricultural sales and income and increases in sales associated with new recreation expenditure. The losses and gains in sales are referred to as the direct effect. The indirect and induced impacts on total income are estimated using a value-added multiplier which measures the total economic income associated with direct, indirect and induced economic effects. The analysis is summarized in Table 7.13.

TABLE 7.13
SUMMARY OF THE ECONOMIC IMPACT ANALYSIS[a]

Change in the Economy		Direct Effect (1,000 $s)	Multiplier[b]	Total Effect[c] (1,000 $s)
Loss of Gross Farm Sales		($800)/yr	2.14	($1,775)
New Household Incomes from Sale of Farm Land[d]		$329/yr	1.12	$368
Onsite Construction Expenditures[e]		$1,225	0.68	$830
Recreation Expenditures	Hunters	$60/yr	1.19	$71
	Birders	$50 to $250/yr	1.15	$58 to $288
	General	$60/yr	1.15	$69

Notes:
[a] Single-value estimates are shown here. The overall evaluation takes uncertainty into account and uses ranges for each of these values (see Chapter 8).
[b] Multipliers were obtained from OMNR's input-output model (SEIM V4.3, Econometric Research Ltd).
[c] Total = Direct, indirect and induced effects.
[d] Assumes that farm families who are displaced stay in Ontario and use proceeds of the farm sale as a retirement fund.
[e] The impact from construction is a short-term effect lasting a few years, whereas the other impacts may last several years.

The estimated impacts shown in Table 7.13 must be interpreted with caution since the underlying analysis entails a rather simple view of the economy. In particular, the analysis assumes that the economy is static and that labour, land, and other resources are all under-utilized. In actuality, economies are very dynamic and, in recent years in Ontario, many sectors of the economy have been operating at or near full capacity. This impact analysis should not therefore be viewed as an assessment of permanent impacts on the economy.

8. Evaluation of the Alternative Design Concepts

In this chapter, a number of alternative design concepts are evaluated in order to assess the overall impact of the proposed facility and to identify an optimal design. The alternative concepts are described in Table 8.1. These alternatives are evaluated from economic, financial, environmental and social perspectives. An environmental screening of the options in accordance with the Ministry of Natural Resources (MNR) Class EA process for small scale MNR projects is included in Appendix J. Under the Class EA, this undertaking will be evaluated according to the Field Environmental Planning Procedure.

TABLE 8.1
DESCRIPTION OF ALTERNATIVE DESIGN CONCEPTS

Scenario	Description
Base Case Scenarios	1,000 acres of shallow marsh, four cells, a small office, hunting on half of the site, minimum programming for visitors
Variations on the Base Case	Variations deal with the physical configuration and are assumed not to affect usage of the site
North portion of study area	Project is located to the north nearer the Walpole marshes and hunted areas near Mitchell's Bay
South portion of study area	Project is located to the south nearer the National Wildlife Area marshes and hunted areas in the South end of the study area
Adjacent to existing wetlands	Project abuts an existing wetland and the dyke along the common boundary is shared
Nearshore to Lake St. Clair	Project is on lands currently used for vegetable production
Inland from Lake St. Clair	Project is on lands currently used for a corn/soy bean rotation
Six marsh cells	Increase the number of cells to six
Three marsh cells	Decrease the number of cells to three
Two Sites	Wetland is located on two separate sites
Enhanced Scenarios	The enhanced scenarios introduce features that are expected to increase use of the site for recreational nature viewing and also enhance biodiversity
Mud Flats	An additional cell is made to create twenty acres of mud flats that will attract shore birds
Mud Flats, wooded swamp, prairie	Site design includes the mud flats noted above, areas of tall grass prairie and wooded swamp, a larger office with interpretive facilities and an enhanced program for users

8.1 Economic and Financial Evaluation

Approach

The economic evaluation is based on the economic and financial performance of each of the design concepts introduced above. The following criteria are used to measure performance:

- Business Enterprise Performance – Net operating revenue is estimated to measure the potential to recover operating costs from operating revenues. Capital costs are not considered since these are recovered from other sources and not operating revenues.
- Net Economic Benefit – Total economic costs, including operating and capital costs, are compared to total benefits, including revenues and user values, to assess whether society as a whole gains or loses as a result of the wetland restoration. The analysis of economic benefit uses two perspectives; a regional perspective encompassing the Municipality of Chatham-Kent and a Provincial perspective.
- Change in Economic Activity – This indicator considers how the Provincial and regional economies are affected by changes in expenditures associated with the facility. The analysis of economic impact uses two perspectives: a regional perspective encompassing the Municipality of Chatham-Kent and a Provincial perspective. Changes in Regional and Provincial economic activity will occur due to losses in agricultural sales, increases in tourism business, and expenditures for land and capital works.

The evaluation is based on estimated values of costs, benefits and expenditures presented in preceding chapters. These values are distributed over periods of varying length within a time horizon of 40 years. For instance, construction of wetland cells and facilities is assumed to take one year to complete while investments to establish prairie, woodland and mud flat habitats are assumed to continue over 6 years. Benefits begin in year 2, grow to their full scale in 2 to 4 years and continue to the end of the planning horizon.

The use of a long-term planning horizon introduces an important complication into the analysis. Current costs and benefits can not be directly compared to estimated future costs and benefits because to do so would ignore the premium we place on present day values over future values. In financial markets, this premium is measured using interest rates. The interest rate used in evaluation studies is called the discount rate. The discount rate used to express future costs and benefits in terms of their equivalent present values. The total present value of a time series of future values is the sum of the present value of each value in the time series. Total present value is also called a capitalized value. The dollar values used to measure the performance indicators in this evaluation are annualized versions of capitalized values. An annualized value takes the capitalized value and distributes it over the planning horizon in a series of uniform annual payments (similar to a mortgage payment). Annualized values are used in this evaluation study because they can be directly compared to each other, like present values, but they are also analogous to readily understood amounts like annual operating budgets and annual debt servicing costs.

Most of the costs, benefits and expenditures presented in preceding chapters are in the form of single value or point estimates even though we know that the estimates are based on various assumptions and are subject to considerable uncertainty. The evaluation recognizes this uncertainty by applying upper and lower bounds to the point estimates. For instance, 25 percent bounds are used for the construction costs, the impacts of changes in expenditures on incomes, and the estimates of recreational use. Ranges for the cost of land are based on reported sales data. Uncertainty bounds on the input data are used to estimate uncertainty bounds for estimates of each of the performance indicators. To determine these uncertainty bounds, alternative estimates of the performance indicators are calculated by allowing each of the input values to vary randomly within the assigned ranges. Calculations are repeated 200 times to provide 200 alternative estimates of each performance indicator. Average values and upper and lower limits are then estimated for each indicator using this sample of 200.

Key findings are presented in chart form below and detailed results are provided in Appendix K.

Economic Evaluation

Figures 8-1 and 8-2 depict total estimated days of recreation per year and total capital costs for nine design options. The northern and southern design options are omitted since they are identical to the base case. It is evident from these charts that total capital costs vary by less than one million dollars across the options, primarily because land costs are 70 percent to 80 percent of total costs. Cost variations between design options are small relative to total costs and relative to cost estimation errors that are expected at this preliminary stage in the design process.

Variations in expected usage are proportionately much greater than variations in cost across the options. However, usage for all of the base case scenarios is expected to be roughly the same. It is also expected that hunting activity will be the same for all of the options. The significant variations in usage are expected to depend on site features of the enhanced design options that diversify the habitat, attract migrating birds and cater to visitors who are interested in wildlife viewing. These changes in usage will govern changes in operating revenues and in economic benefits. For this reason, subsequent comparisons of the options focus on just three options, the base case option and the two enhanced options, namely the base case with mud flats and the base case with diverse habitats and an interpretive centre (called base case, mud flats, and interpretive centre, respectively).

FIGURE 8-1
TOTAL DAYS OF RECREATIONAL USE

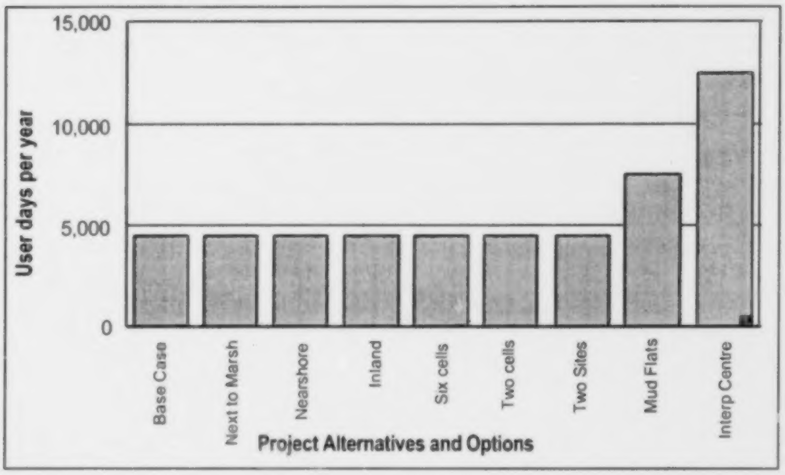
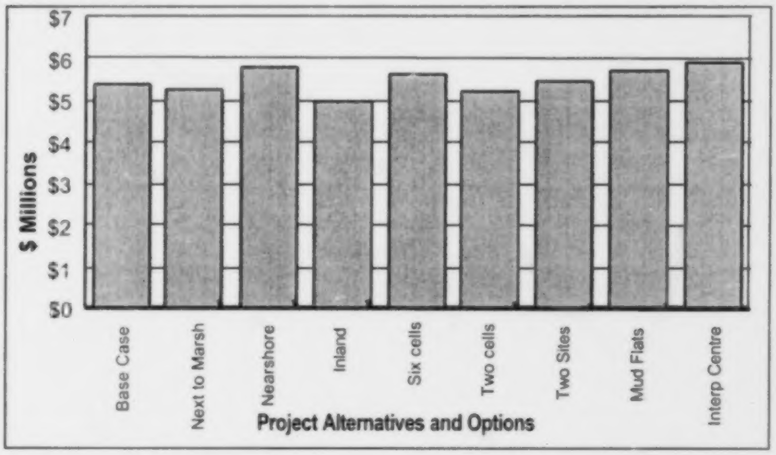


FIGURE 8-2
TOTAL CAPITAL COSTS

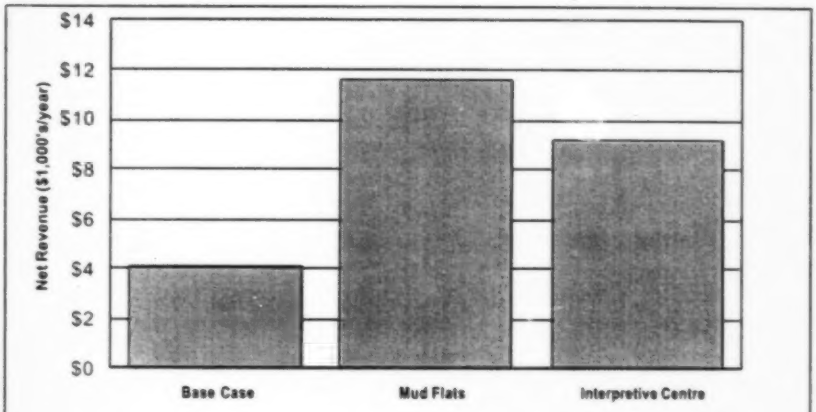


Business Enterprise Performance

The business enterprise performance of all three scenarios is forecast to be acceptable since revenues from users should cover operating costs (see Figure 8-3). This assumes modest entry fees for general users and nature viewers and a daily $50 fee for hunters. It also assumes that there is a single controlled access point with staff available to collect user fees. Even though mud flats increase operating costs significantly, the mud flats option shows the best cost recovery because it is expected to attract a lot of birders. This assumes that shore birds are attracted to the restored mud flat area. Changes in the assumed interest rate for the analysis cause all of the measures of business performance to change (Figure 8-4), but not to such an extent that the above conclusions would change.

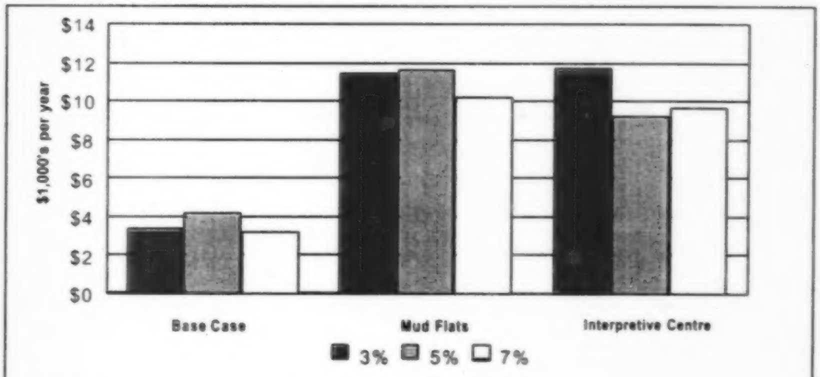
The business enterprise performance of all three scenarios is forecast to be acceptable since revenues from users should cover operating costs.

FIGURE 8-3
BUSINESS ENTERPRISE PERFORMANCE



NOTE: Shows estimated operating revenues less operating costs. 5% discount rate

FIGURE 8-4
BUSINESS PERFORMANCE – ALTERNATIVE INTEREST RATES



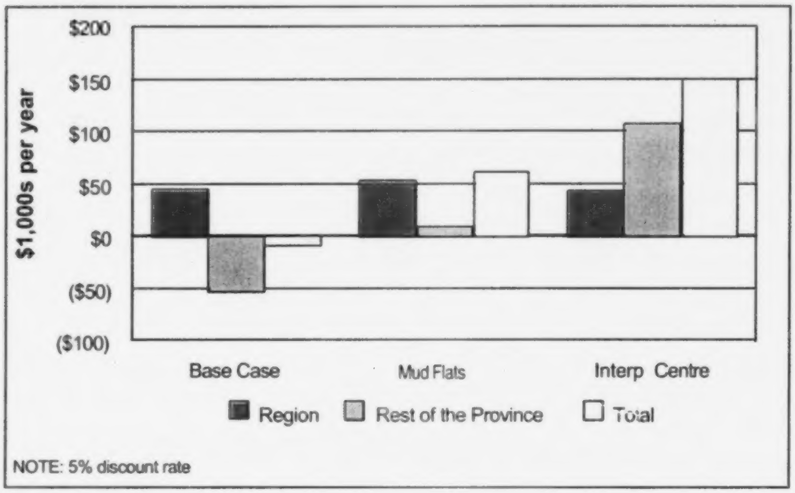
NOTE: Chart shows revenues less operating costs

Net Economic Benefit

The assessment of net economic benefit is favourable for the Region, but provincially the outcome is mixed.

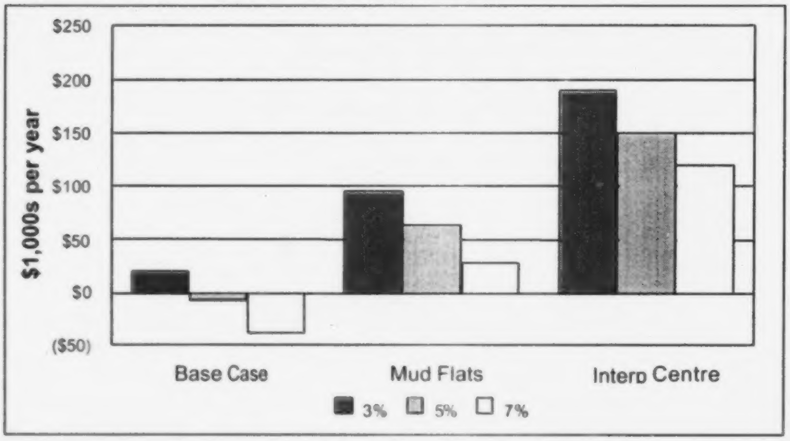
The assessment of net economic benefit (Figures 8-5 and 8-6) is favourable for the Region, but provincially the outcome is mixed. Regionally, benefits exceed costs because regional costs do not include any capital costs, which are covered by sources outside of the Region. For the rest of the province, net benefits are negative for the base case, marginally positive for mud flats and positive for the interpretive centre design. This profile of net benefits is to be expected since general use and hunting use benefit primarily Regional users, whereas a significant number of users with an interest in wildlife viewing come from elsewhere in the Province. High usage by individuals from outside the Region is sufficient to offset the high cost incurred outside of the Region for capital works.

FIGURE 8-5
NET ECONOMIC BENEFITS BY AREA



NOTE: 5% discount rate

FIGURE 8-6
PROVINCIAL NET BENEFITS – ALTERNATIVE INTEREST RATES



As before, changes in the interest rate change the estimates of net benefit but not by enough to change the conclusions. This is also the case when land costs are increased in keeping with local comments suggesting that assumed costs are on the low side. The cost of land for vegetable production was increased from $4,500 to $6,000 per acre and the cost of land that is used for field crops was increased from $3,700 to $4,450 per acre. These changes caused annual net benefits for all of the options to fall by about $20,000, but net benefits for the mud flat and interpretive centre options were still positive. A loss of U.S. contributions towards capital costs has a much more adverse impact, annual net benefits for all options fall by about $200,000 and are negative in all cases; however, this is an unlikely scenario.

Changes in Economic Activity

Changes in overall economic activity can occur as a result of the following local changes:

- The loss of agricultural production and sales on 1,000 acres and the associated loss of agribusiness sales and retail sales to displaced farm families
- An influx of cash, especially from U.S. contributors, to purchase land from local landowners and the associated gain in household incomes and retail expenditures that are made by benefiting households that stay in the area
- Expenditures on capital works onsite and the associated increase in sales of suppliers to the contractors and of retail sales of households that receive income from the new work
- Expenditures related to new recreation on site and the associated increase in sales of suppliers to the tourism service industry and of retail sales to households that receive income from the new tourism business

Economic impacts on the regional economy are expected to be negligible.

All of these various impacts have been evaluated. The net result, depicted in Figures 8-7 and 8-8, indicates an overall loss of economic activity for the base case and the mud flats design options and a gain for the interpretive centre option. The annual change in economic activity, in all cases, is in the order of a few hundred thousand dollars or less (up to about a $350,000 loss for the base case option with a three percent interest rate (Figure 8-8). To put this loss in perspective, total annual income related to agricultural production in the Municipality of Chatham-Kent is in the order of $750 million.[5] The total impact, whether a gain or a loss, is therefore only one twentieth of one percent of total farm related income. Under a worst case scenario, which ignores gains from construction and the farm land sales, the loss is only one tenth of one percent of farm related income. Economic impacts on the regional economy are therefore expected to be negligible.

Uncertainty Analysis

The final results of the economic analysis, depicted in Figures 8-9 through 8-11, summarize the analysis of uncertainty of the estimates. These summaries show upper and lower limits for measures of business performance, net economic benefit, and changes in economic activity. For each indicator, there is a five percent chance, or a one in twenty chance, that the actual impact lies outside of the range defined by the upper and lower limits for that indicator.

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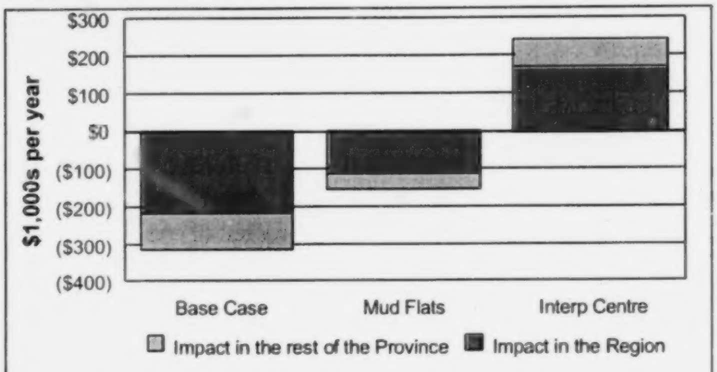
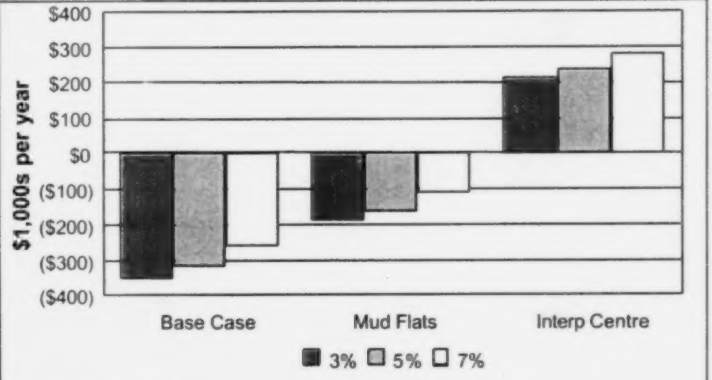
[5] This amount represents total valued added including direct, indirect and induced income effects and is based on an estimate of gross annual farm sales of $350 million.

FIGURE 8-7
CHANGE IN ECONOMIC ACTIVITY BY AREA



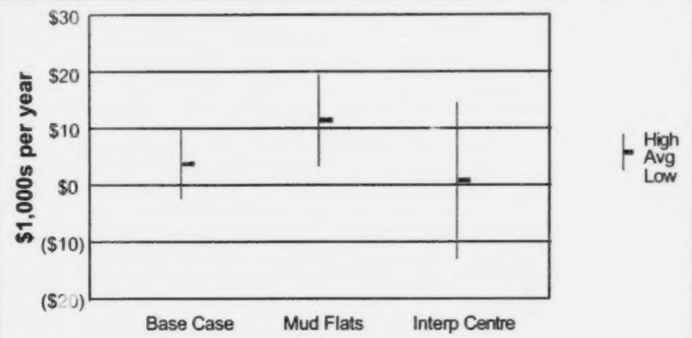
NOTE 5% discount rate. Based on a conservative estimation procedure. Size of the actual changes will likely be less.

FIGURE 8-8
ECONOMIC ACTIVITY – ALTERNATIVE INTEREST RATES



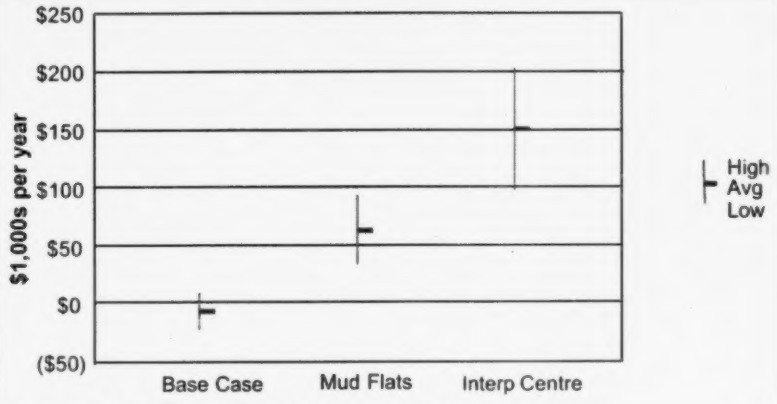
NOTE Shows total Provincial changes.

FIGURE 8-9
BUSINESS PERFORMANCE – HIGH/LOW RANGE



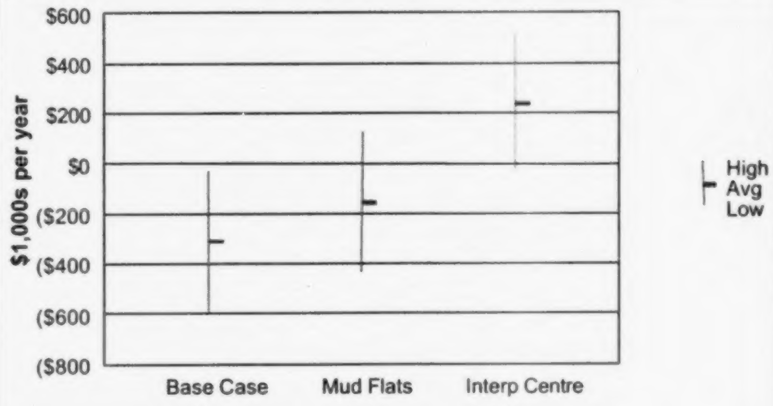
NOTE: Shows operating revenue less operating costs at a 5% interest rate. High and Low vlaues represent two standard deviations.

FIGURE 8-10
PROVINCIAL NET BENEFIT – HIGH/LOW RANGE



NOTE: Shows total Provincial benefit. High and low values represent 2 standard deviations. 5% interest rate.

FIGURE 8-11
PROVINCIAL ECONOMIC ACTIVITY – HIGH/LOW RANGE



NOTE: Shows total provincial impact. High and low values represent 2 standard deviations. 5% interest rate.

From the perspective of business performance, it appears that the mud flats option is the best option in terms of the highest expected net operating income and the lowest risk of loss, while the interpretive centre option is poorest in both respects (Figure 8-9). The assessment of net public benefit yields the opposite result; the interpretive centre option has the highest net economic benefit even after risk is taken into account. The interpretive centre option also shows the best performance in terms of impact on economic activity, with only a small chance that a loss in activity might occur with this.

These results imply that an optional business strategy would entail the initial development of the mud flats option. If something resembling the interpretive centre option is eventually desired because of the public benefits that it creates, then such a centre could be developed more gradually building on the experience and knowledge gained by running a more modest facility. Such an approach might also allow time to assess the impacts of increased use of the facility on the ecology of the wetland and the ecological benefits that are expected.

8.2 Social Implications

The restoration project will yield strong and significant social benefits to the local and surrounding areas, some of the benefits are measurable, while others less tangible. Some of the key benefits that will be provided by the restored wetland are listed below.

The project provides significant social benefits that will contribute to improving the quality of life in the Chatham Kent region.

- Increased outdoor recreational opportunities including hunting, nature appreciation, etc.
- Enhanced natural heritage educational or research opportunities
- Contribution to local cultural heritage
- Development of a new local recreational resources and infrastructure, including opportunities to enhance the facility over time through local initiatives
- Positive existence value

Many of the benefits have been described in more detail in the economic analysis but are also significant in terms of their social implications, irrespective of their economic effects.

The social analysis also revealed that publicly raised issues and concerns from the initial consultation concerning the project can be satisfactorily addressed either through facility siting and design or through the commitment of the EHJV partners to adaptive and inclusive management of the project.

For the purpose of analysis, the potential social implications for the project are deemed to be largely independent of its general location. Conclusions of this analysis are based on a review of the literature, comparative analysis of similar sites, feedback from the Local Advisory Committee (LAC), input from the Lake St. Clair (LSC) Steering Committee and interviews with local residents and business operators.

Recreational Opportunities

Depending on the final design, the restoration project is expected to generate new recreational activity, primarily for birding, nature viewing and hunting. A basic wetland site with limited facilities is anticipated to generate about 2,000 visitors per year. A site featuring a mix of habitats and with limited user facilities could generate 5,000 visits per year. The enhanced facility design concept, featuring a more diverse mix of habitats, facilities and design features that cater to nature viewing and outdoor recreation, could expect to generate about 10,000 visitors per year.

Any opportunity for new and publicly accessible outdoor recreation opportunity in the study area is a significant and a positive contribution to quality of life. These opportunities are currently very limited. In addition to social benefits derived from participation in these activities and their economic impacts, the facility has the opportunity to become a valued community resource and recreation destination.

Positive social benefits are provided, in part, by creating new recreational opportunities for local residents.

The restored wetland is also anticipated to generate approximately 500 hunter days of activity during the waterfowl hunting seasons. Given the limited public access to the Lake St. Clair shoreline, combined with the number of privately owned hunt clubs, public opportunities for affordable waterfowl hunting are very limited locally. As a result, existing publicly accessible hunting sites are used at or beyond capacity at peak times of the year. The restored wetland will provide new public waterfowl hunting opportunities. Hunting is a significant component of local cultural heritage; therefore increasing the opportunity for the general population to participate locally is viewed as a significant and positive contribution of the restoration project. In addition, because the nature of the hunting experience that will be offered by the restoration project is not expected to interfere with the operations of local outfitters and guides, the positive impact of the restored wetlands is further increased.

Opportunities for hunting of other species (e.g. upland animals) may be possible depending upon where the project is ultimately located and as the facility and habitats develop. Although opportunities for other types of hunting have not been explored in detail, the potential effects are expected to be minor but positive.

Heritage Appreciation

Wetlands, hunting and agriculture are fundamental elements of the natural and cultural heritage of the Kent, Lambton and Essex region, broadly, and of the EHJV project study area in particular.

Consolidation of drainage legislation in 1874 facilitated the construction of outlet or main drains in many parts of southern Ontario by permitting a majority of property owners in an area to petition the municipality for drainage works. In the late 1800s, important technological innovations further stimulated agricultural drainage. In fact, the Municipality of Chatham-Kent was at the forefront of some of this technological development. Lauriston (1952) reported that Samuel Martin bought 600 acres (243 ha) of the Dover Community marsh in 1878. Martin dyked 50 acres of this property and developed a sixteen foot diameter scoop water wheel which he used successfully to drain off water in 1880 and to harvest corn that same year. In the three decades that followed, numerous large-scale wetland drainage projects were completed in Kent and Essex counties, contributing to the agricultural vitality of the region.

The Lake St. Clair marshes were hunted and trapped by early European settlers and Native North Americans. The cultural importance of these activities continues today, as is evidenced by the local hunting industry. Muskrat are still trapped for fur and meat and are considered a local delicacy.

In recent decades the value of wetlands in their natural state has become widely recognized. Appreciation of natural and cultural heritage has also grown. Heritage appreciation, for example, is now an important activity in many national and provincial parks and conservation areas.

The EHJV restored wetland facility has the opportunity to provide a significant local venue for citizens and families to experience and enjoy and a major component of local cultural heritage. Even minimal passive programming, such as signage or display panels, will serve to heighten awareness and appreciation of the cultural heritage values and history of the area associated with activities/land uses such as hunting, trapping, agriculture and outfitting. They should also serve to increase awareness and appreciation of the natural heritage values of the area's landscape, both current and historical, through access to natural features like marsh, tall grass prairie and wooded swamp.

Environmental Education

Environmental education is a component of school curriculum, especially at the elementary level. Presently within the study area, levels of environmental education and research are minimal, and no significant interpretative signage exists. In the early part of 1999, five elementary school groups and one secondary school group visited the St. Clair National Wildlife Area (NWA), representing about 170 students in total. Current low levels of this kind of activity may reflect several factors, including lack of awareness/promotion of the St. Clair NWA, lack of publicly accessible wetlands in the area, and lack of parking, washrooms and interpretative facilities.

Discussions with Lambton-Kent District School Board officials suggest considerable potential educational use of a restored wetland in the study area (Downey, 1999; Livingstone, 1999). There are 28 public elementary schools in the former Kent County division of the school district; 8 to 10 school trips annually are typical of an elementary school, and about 25 percent of school trips have an environmental focus (Livingstone, 1999). This trend will not diminish; the new science curriculum, for example, places some emphasis on environmental education and a more hands-on approach to education is expected (there is now a requirement for a "pond study").

A restored wetland in the EHJV project study area would be a very attractive opportunity for educators.

It is estimated that elementary schools in the Chatham-Kent region take 55 to 70 field trips annually which have an environmental focus. Assuming that there are 25 students per trip, this involves 1,400 to 1,750 students. If this assumption is applied to the seventeen elementary schools in just the Kent portion of the St. Clair Catholic District School Board, then there would be 35 to 40 environmentally focussed school trips annually that would involve 900 to 1,000 area students. Secondary schools would also generate a limited number of additional trips.

What does this imply for educational use of a restored wetland in the area? The experience at Hilliardton Provincial Wildlife Area (see Section 5) shows what can be accomplished when even one teacher demonstrates environmental education leadership. Moreover, the availability of local, and inexpensive, school trips is a serious concern for school officials (Livingstone, 1999). In this regard, a restored wetland in the EHJV project study area would be a very attractive opportunity for educators. If, for example, just one-quarter of the estimated existing environmentally-related school trips were to use the wetland project site, the results would be about 25 trips annually, involving about 600 students. This is four to five times the current educational use of the St. Clair National Wildlife Area.

Students visiting wetlands

A second concern of educators, however, is the availability of trained individuals to adequately interpret the site. Interpretive signage, brochures and other teaching materials are helpful, but educators value an experienced person who can present a meaningful interpretative package and interact with students. The availability of such a person, on an appointment basis, would add considerably to the educational appeal of a restored wetland. This person might be a Canadian Wildlife Service, Ministry of Natural Resources, or conservation authority staff person; however, local historical or wildlife-related organizations may represent a source of interested volunteers. Experiences elsewhere (e.g. Bluewater Interpreters at Tiny Marsh Provincial Wildlife Area (Section 5)), demonstrate commercial interpretative opportunities. Certainly, there is no shortage of local natural and cultural heritage to interpret, given the significance of wetlands and agriculture noted above.

Research

There is no evidence readily available to suggest what kind of research potential a restored wetland in the area might have. Research does occur at several of the comparative wetland sites investigated (Section 5), including Hilliardton PWA, the Ottawa and Montezuma National Wildlife Areas and Pickerel Creek Wildlife Area. The restoration will undoubtedly provide an opportunity for further research, which could be significant depending on how it is ultimately used and by whom. The proposed inclusion of additional habitats including mudflats, wooded swamp and tallgrass prairie would increase the research potential of the site.

Existence Value

The existence values of the restored wetland reflect a non-monetary benefit derived from the restoration project that corresponds to a sense of personal happiness or enjoyment that results because of the presence of the restored wetland. Qualitatively, the restoration project will likely contribute to increasing the quality of life locally and will be perceived as a positive amenity; therefore making the Chatham-Kent area are more desirable place to live for some people. Existence value will vary among individuals, but overall it will be positive for the community.

Potential Nuisance Impacts

The potential exists for local area residents to experience nuisance impacts as a result of the restored wetland project and it subsequent use. Common impacts that might develop could include trespassing, litter, noise, and parking/traffic issues. While none of these issues were noted as being significant in the minds of some local residents, either during this study or in the Phase I consultations, they were apparent at some of the comparative sites. Each of these potential negative impacts can be successfully mitigated with adequate pre-emptive site planning and future management of the site. It is very unlikely that they will negatively impact the study area in the future.

Crop damage resulting from waterfowl depredation was identified as a concern during the Phase I consultations. The finding of this study suggests that, should the project proceed, this should not be a significant occurrence locally. The reasons for this finding are:

- Modern grain harvesting methods and equipment operate with much greater efficiency than swathing and older equipment; as a result there is very little opportunity for waterfowl depredation other than feeding on the waste grain remaining on field.
- Local farmers indicated that crop depredation is not a problem under existing waterfowl pressure, even in areas adjacent to existing wetland.
- The NWA has never received a request for a permit to kill nuisance waterfowl from any property owners in the vicinity.
- Proven mitigation or compensation measures are available should a serious situation develop at some point in the future.

Issues Identified During Phase I Consultations

A study was undertaken in the summer of 1998 to conduct an initial public consultation to identify issues and concerns with the proposed undertaking (Monteith Zalinka Priamo, 1998). The community's opinions concerning the proposed restoration were generally positive; 48 percent of the area's residents supported the proposal while only 19 percent were opposed to it. Roughly one third of the public polled felt that they needed answers to a number of questions before making up their minds. Table 8.2 lists outstanding issues that the community felt needed to be addressed and describes how these issues have been addressed and assessed in the present study.

TABLE 8.2
TREATMENT OF PUBLIC ISSUES AND CONSENSUS IDENTIFIED IN PHASE 1 CONSULTATIONS

Issues Identified of Public Concern (Montieth Zelinka Priamo Ltd., 1998)	Findings from Socio-Economic and Environmental Evaluation
Identify realistic and potential economic and environmental benefits of the project for the local community.	This issue was one of the main guiding forces of the socio-economic and environmental evaluation. The results presented throughout this report indicate that overall economic and effects of the project are expected to be negligible or slightly positive and social effects will be positive and significant. Environmental benefits are expected to be substantial and result from the provision of additional habitats and the potential to increase biodiversity (see Sections, 5, 6, and 7 for a detailed description of these findings).
Provide more detailed information on the need for wetland and the key functions it is expected to perform. Explain the need for the sanctuary function, and what "habitat" entails.	Details on these issues are provided in the Section 4 and 6.
Set out possible options for use of the wetlands explaining how good management practices would affect ability to use certain areas for certain uses at certain (or all) times of the year.	These are described in Section 4 and were developed jointly with the LSC Technical Committee and the LSC Local Advisory Committee. A fundamental principle of this project is to incorporate multi-use public access within reasonable limits associated with maintaining and enhancing the primary objective of providing waterfowl staging habitat.
Present alternative approaches for establishment of wetlands: 1,000 acres in one area? What would the approach be if the 1,000 acres could not be acquired in one area? Give reason for the preferred approaches.	A number of alternatives have been examined. Details are provided in Section 8 and Appendix J.
Describe what other broad options were considered. Why not choose areas of poor farmland? Why not create wetland near Rondeau or other sites away from Lake St. Clair?	A number of alternatives have been examined. Details are provided in Section 8. All land in the study area is commercially valued for agriculture. The Lake St. Clair region is located at the junction between the Mississippi and Atlantic Flyways. As such it provides geographic-specific habitat important to migratory bird species. The EHJV will be evaluating other projects in other areas of the province in the future.

TABLE 8.2
TREATMENT OF PUBLIC ISSUES AND CONSENSUS IDENTIFIED IN PHASE 1 CONSULTATIONS

Issues Identified of Public Concern (Montieth Zelinka Priamo Ltd., 1998)	Findings from Socio-Economic and Environmental Evaluation
Determine the potential impact on municipal assessment, whether any offsetting measures are warranted.	The proposed wetland will be neutral with respect to municipal assessment. The EHJV has committed to maintaining the tax base from the site.
Provide information on funding sources. Clarify role of Canadian federal and provincial component of funding. Specifically address whether general tax revenues will be used.	Sixty-five to 70 percent of the funding for this project is expected to be derived from US sources (and/or from other private sources) and will largely cover the capital cost associated with the restoration. It is anticipated that a significant portion of continued operation and maintenance costs will be recovered from revenue generated by the facility (see Sections 7 and 8).
Document why establishing wetland in the Lake is considered cost-prohibitive.	In order to provide suitable staging habitat it is necessary to create a dyked wetland that enables water levels to be controlled within the wetland. The cost of building and maintaining a dyke system that would meet the engineering and safety requirements of a lake environment are cost prohibitive compared to an inland site.
Provide a firm statement of provincial policy regarding new wetlands and "adjacent lands", and restrictions which will be applied.	The MNR, as a significant partner in the EHJV, has recognized this potential conflict and is committed to the need for fair and flexible interpretation and application of the policy, given the nature of the proposed project (see Section 4). Any new restrictions resulting from the presence of the facility are expected to be minor in relation to restrictions that already exist through the application of provincial and municipal agricultural policies.
Give a clear message that the acquisition of land will be by purchase from willing sellers – there will be no expropriation (nor is there any ability to expropriate).	The proposed wetland will proceed only on a willing seller basis for land acquisition (see Section 4).
Provide information on risk of crop damage to nearby farms, depredation by birds, risk of spreading nematodes to soybean crops, etc. (What has been the experience close to existing wetlands?) Use OMAFRA sources wherever possible.	Based on key informant interviews with farmers in the study area, from data collected through the comparative site analysis, and review by OMAFRA, the risk of crop damage is evaluated as extremely low (see Section 7).
Consider need for, and feasibility of crop damage compensation.	See previous.
Clarify whether project could have any role in purification of water.	Given the siting requirements (e.g. distance from urban areas), it is unlikely that the proposed wetland could provide additional water purification without significantly increasing costs of the project.

TABLE 8.2
TREATMENT OF PUBLIC ISSUES AND CONSENSUS IDENTIFIED IN PHASE 1 CONSULTATIONS

Issues Identified of Public Concern (Montieth Zelinka Priamo Ltd., 1998)	Findings from Socio-Economic and Environmental Evaluation
Describe interrelationships of the project with existing drainage works. What measures would be taken to prevent adverse effects?	The proposed wetland would be hydrologically isolated from the existing drainage network by dykes. Once the wetland cells are initially filled with water, only periodic pumping will be required to manage water levels as precipitation normally exceeds evaporation in the area. Operational guidelines will be developed once a specific site is selected and will prevent significant adverse affect to other users (e.g. agricultural community) for any additional water needs.
Set out optional structures and mechanisms to ensure effective local input into the wetland designs and management decisions, both initially and on an ongoing monitoring basis.	The EHJV partners have recognized a commitment to ensuring ongoing local input to the project through the establishment of the LAC. It is anticipated that the LAC, or some similar mechanism, would have continued involvement throughout the development phase of the project, including management and operation. Similarly, the formation of a Management Advisory Committee would be a possible mechanism to ensure the projects operates within expectations. This project is also subject to the requirements of the Environmental Assessment Act and the Environmental Bill of Rights with respect to consultation.
Clarify that the Project will not block existing public access to the lake and existing wetland areas.	The project will be designed in such a way as to not further restrict public access to the lake and existing marshes.
Set out possible types of public access to the project (e.g. nature trails, hunting for the average person, canoeing?).	A fundamental principle of this site is to incorporate multi-use public access within reasonable limits associated with maintaining and enhancing the primary object of providing waterfowl staging habitat. Possible future uses of the site are described in Section 4.
Give a clear statement that the Project will not be a private club for members only.	A fundamental principle of this site is to incorporate multi-use public access within reasonable limits associated with maintaining and enhancing the primary object of providing waterfowl staging habitat. Public access to waterfowl hunting opportunities is a highly desired future activity for the site.

Summary

The proposed wetland restoration will provide positive social benefits, primarily through the creation of new recreational opportunities for local residents. These opportunities will be available, to varying degrees, at all times of the year. Multi-use and public access are fundamental design and operation considerations for the restoration project. Local residents will be in close proximity to enjoy the many anticipated activities available at the site, as described in Section 4 (e.g. hunting, nature viewing, etc.). The presence of the new facility and the recreational opportunities that it will create, will add to the attractiveness of the area as a place to live and conduct business.

The EHJV partners are committed to an adaptive and inclusive management approach to the facility. This approach will be important to maximizing public benefits of the restored wetland environment.

8.3 Environmental Implications

Design implications for the wetland restoration project are discussed in Chapter 6 of this report. In general, waterfowl and other wetland species will benefit if the proposed wetland is created closer to existing wetlands and closer to Lake St. Clair. A greater number of wetland cells may reduce risk of wetland failure in any one cell, but would also introduce a greater dyke network that could be used by land-based predators.

As a general rule, the greater the number of habitat types, the greater the number of species that will be attracted. The restoration project of the principal habitat type, shallow marsh, will attract a host of new species to the area in addition to attracting migrating waterfowl. Some other habitat types, although not attractive to migrating waterfowl, will serve to attract additional new species to the area, some of which are rare.

Existing agricultural lands and drains in the Study Area have the potential of supporting 276 species of plants, butterflies, amphibians and reptiles, birds, and mammals taken as a group (termed 'total biota' in this report). For the purposes of this study, bird species numbers include migrant waterbirds, such as ducks, geese, and shorebirds. Total biota of existing agricultural fields and drains include one rare animal species and 13 rare plant species. Rare species include those that have been given status of threatened, vulnerable, or endangered by COSEWIC, and/or have been given the rank of S1, S2, or S3 by the NHIC.

Of the proposed habitat types to be restored, the greatest number of species is associated with shallow marsh, followed by swamp, tall grass prairie, upland on the dykes, and mudflats. For comparative purposes, an upland woodland is slightly higher than tall grass prairie in terms of total biota. Shallow marsh also accounts for the greatest number of rare species, followed by tall grass prairie, swamp, and uplands on dykes. Shallow marsh contains by far the most species of animals (113), followed by swamp (67), woodland (63), existing agricultural lands and drains (59), the uplands of the dykes (45), tall grass prairie (39), and mudflats (13) (Figure 6-3). For comparison, upland woodland is expected to harbour roughly half of the number of animal species that shallow marsh will harbour. Shallow marsh is also expected to contain the most native plant species (270). Tall grass prairie and upland associated with dykes are noticeably less in number of plant species (108 and 100 species, respectively).

Least bittern

Restoration of proposed habitat types could more than double the total biota in the area to 804 species (Figure 6-5). Of the 534 additional species provided for by the restored habitat types, 135 are animals and 399 are plants (Figure 6-6 and Figure 6-7). Twenty of the additional animal species and 39 of the plant species are considered rare. Of course, each of the various habitat types is associated with a suite of species not found in any other habitat type. The shallow marsh and uplands associated with the dykes, which will cover most of the restored area, account for half (269 or 50 percent) of the new species. Mudflats, while not adding any new species, will increase the habitat suitability and area available for migrating shorebirds; this should increase the number of migrating shorebirds using the area as well as prolong the duration of their stopover. Swamps and tall grass prairie could add 91 (17 percent) and 72 (14 percent) additional species to the area, respectively. For comparative purposes, restoring upland woodland could add 102 species; however, many of these woodland species, especially woodland plants, would not emerge for several decades, if not centuries, unless transplanted by humans.

In summary, all of the proposed habitat types will be inhabited by species that would not otherwise be found in the existing agricultural fields and drains. The shallow marshes and dykes associated with the waterfowl staging areas will account for most of the new species that could exist locally if all of the proposed habitat types are restored. However, many additional species will not occur in the area if only the marsh cells and dykes are established.

A qualitative summary of design options is presented in Table 8.3.

8.4 Summary

Alternative design concepts are evaluated from economic, financial, environmental, and social perspectives.

Economic Evaluation

The economic evaluation is based on the economic and financial performance of each of the design concepts introduced above. The following criteria are used to measure performance:

- Business Enterprise Performance – Net operating revenue is estimated to measure the potential to recover operating costs from operating revenues.

TABLE 8.3
LAKE ST. CLAIR WETLAND RESTORATION DESIGN CONCEPTS – SCREENING MATRIX

Ecosystem	Waterfowl Habitat	Biodiversity	Rare Species
Location – Basic Wetland Design			
North portion of study area	Not significant	+ Close to large number of species on Walpole Island	+ Close to large number of rare species on Walpole Island
South portion of study area	Not significant	- Fewer species in the south	- Fewer rare species in the south; + Would offer colonization opportunity
Adjacent to existing wetlands	+ Increase in the effective wetland size; + Potentially more attractive to waterfowl	+ Potentially faster colonization by plants and animals in adjacent wetland	+ Potentially faster colonization by plants and animals in adjacent wetland
Near shore to Lake St. Clair	+ Close to open water for refuge; + Close to main waterfowl congregation areas	+ Generally closer to species-rich areas	+ Generally closer to species-rich areas
Inland from Lake St. Clair	- Farther from open water for refuge; - Farther from main waterfowl congregation areas	- Generally more distant from species-rich areas	- Generally more distant from species-rich areas
Proximity to communities	- Conflict with hunting activities; - Increased human disturbance	- Increased human disturbance may cause some species to be absent	- Increased human disturbance may cause some species to be absent
Site Design – Basic Wetland Design			
Large number of cells (6)	- Greater number of inroads for mammal predators; + Management failure of one cell not as critical to overall wetland area	+ Greater opportunities for management control for specific species or groups	+ Greater opportunities for management control for specific species or groups
Small number of cells (2)	+ Larger contiguous blocks of wetland; less edge; - Management failure of one cell is more critical	- Less management opportunities	- Less opportunity to offer specialized habitat
Two sites	+ Greater dispersal of waterfowl opportunities in the study area	- Less opportunity for larger blocks of alternative habitat at each site	- Less opportunity to offer specialized habitat
Habitat Design Enhancements			
Mudflats	- Not attractive to waterfowl if managed as shorebird habitat	+ Can be managed as shorebird habitat	+ May attract rare shorebirds
Swamp	- Loss of more valuable habitat for migrating waterfowl; + Potential breeding habitat for wood ducks	+ Increase in habitat types present and associated plants and animals	+ Could potentially attract rare bird species associated with swamps
Other habitat	- Loss of waterfowl staging area if upland replaces some of the 1,000 ac. Of wetland; + Potential waterfowl nesting areas if upland areas are large enough to counter predation effects and area is in addition to 1,000 ac.	+ Increase in habitat types present and associated plants and animals	+ Could potentially attract rare bird or other species associated with other habitat types (e.g. prairie)
Enhanced Facilities	+ Opportunity for adding habitat features such as fruit-bearing shrubs, conifers, etc. to increase habitat for migrating birds	+ Increase in habitat types present and associated plants and animals	+ Could potentially attract rare bird or other species associated with other habitat types (e.g. prairie) - Increased human disturbance may cause some species to be absent

- Net Economic Benefit – Total economic costs, including operating and capital costs, are compared to total benefits, including revenues and user values, to assess whether society as a whole gains or loses as a result of the wetland restoration.
- Change in Economic Activity – This indicator considers how the Provincial and regional economies are affected by changes in expenditures associated with the facility.

Total capital costs vary by less than one million dollars across the options, primarily because land costs are seventy percent to eighty percent of total costs. Cost variations between design options are small relative to total costs and relative to cost estimation errors that are expected at this preliminary stage in the design process.

The business performance of all three scenarios is forecast to be acceptable since revenues from users should cover operating. This assumes modest entry fees for general users and nature viewers and a daily $50 fee for hunters. It also assumes that there is a single controlled access point with staff available to collect user fees.

The assessment of net economic benefit is favourable for the Region, but Provincially the outcome is mixed. Regionally, benefits exceed costs because regional costs do not include any capital costs, which are covered by sources outside of the Region. For the rest of the province, net benefits are negative for the base case, marginally positive for mud flats and positive for the interpretive centre design.

The net result indicates an overall loss of economic activity for the base case and the mud flats design options and a gain for the interpretive centre option. An enhanced facility therefore provides the most positive benefits.

Environmental Effects

The greater the number of habitat types, the greater the number of species that will be attracted. The restoration of the principal habitat type, shallow marsh, will attract a host of new species to the area in addition to attracting migrating waterfowl. Some other habitat types, although not attractive to migrating waterfowl, will serve to attract additional new species to the area, some of which are rare (see Section 6).

Social Implications

The proposed wetland restoration project will provide positive social benefits, primarily through the creation of new recreational opportunities for local residents. These opportunities will be available, to varying degrees, at all times of the year. Multi-use and public access are fundamental design and operation considerations for the restoration project. Local residents will be in close proximity to enjoy the many anticipated activities available at the site, as described in Section 4 (e.g. hunting, nature viewing, etc.). The presence of the new facility and the recreational opportunities that it will create, will add to the attractiveness of the area as a place to live and conduct business.

The EHJV partners are committed to an adaptive and inclusive management approach to the facility. This approach will be important to maximizing public benefits of the restored wetland environment.

9. Lessons Learned

One of the purposes of this study was to generate a process and method that might be used to assist in the evaluation of similar Eastern Habitat Joint Venture (EHJV) projects.

While each future project/situation will have unique characteristics and circumstances that will need to be addressed, this project generated a basic work plan that can be used as a basis for undertaking similar evaluations in the future.

This section provides an outline of the generic work plan and concludes with a list of lessons learned. It is hoped that these lessons can be adapted and transferred to facilitate future projects.

The evaluation of the proposed Lake St. Clair wetland restoration generated a basic work plan that can be used as a basis for undertaking similar evaluations in the future.

9.1 Generic Work Plan

Table 9.1 provides a generalized work plan of the processes and methods that were used in this study. Site-specific details and assumptions for the Lake St. Clair (LSC) evaluation can be found in the appropriate section of the report.

Much of the data generated for this study can be directly applied to the evaluation of subsequent projects; particularly the information concerning capital costs and operating budgets, expenditure data and use assumptions. Similarly, the comparative site analysis (Section 5) has generated new empirical data on the Ontario and Great Lakes wetlands that was not readily available prior to this evaluation. Other information, such as social effects and implications for agriculture, will need to be evaluated on a project by project basis using local data.

TABLE 9.1
GENERIC WORK PLAN

Task	Description of Approach	Data Sources/Comments
Socio-economic Inventory	Assemble information on:	
	• Population and land use (existing status, trends), economy (income and employment by sector)	• Statistics Canada (Census of Population, other publications-Down load from Statistics Canada web site), Chamber of Commerce, local municipalities (Official Plans, strategic plans and documents, etc.)
	• Agriculture (crop systems, livestock, irrigation, capital, land use, drainage)	• OMAFRA land use and crop system maps, Census of Agriculture, local OMAFRA staff
	• Recreation, tourism and travel	• MNR, Environment Canada and International Joint Commission data
	• Municipal tax base	• Local municipalities, Provincial Government
Physical and biological inventory	Assemble available information on:	
	• Topography and drainage, waterways, existing and historical wetlands, soil type and class, ecosystem units, waterfowl and other fauna, flora, fisheries (spawning, feeding, etc.), endangered species, natural resource constraints, and impairments.	• MNR Natural Resource Values & Information System, Natural Heritage Information Centre, Canadian Wildlife Service, IJC studies, locally compiled faunas and floras.
Literature review	Review economic evaluation literature dealing with wetlands and related resource-based activities (hunting, fishing, nature viewing, hiking, existence and bequest, etc.).	Bardecki's bibliography (1998), Web search, university libraries (online searches at Ryerson, Guelph and Waterloo). Key informants and Environment Canada's Environmental Valuation Reference Inventory.
Public Involvement	Ask project advisory committee to participate in the review of the work plan if feasible (subject to approval of client). Newspaper notice of study initiation (800 number access). Conduct key informant interviews to obtain local information on wetland uses and values, and on public priorities associated with issues identified in the Phase 1 consultation exercise.	Review Phase 1 work (Monteith Zelinka Priamo Ltd, 1998) for info on significant issues. Prepare and publish public information materials in co-operation with client. Establish 1-800 line at set up protocol for documenting calls and arranging follow up as required. Conduct key informant interviews. Target efforts to address specific local issues like competition between wetlands and concerns over drainage and cropland pests.
Comparative Site Analysis	Select 4 to 6 natural and/or restored wetlands in Ontario and the US Great Lakes Basin to gather data on experiences and effects including local economic spin-off activity, agricultural impacts, land values, land use developments, recreation activities and businesses, and potential conflicts and resolutions.	Establish criteria with which to select suitable sites. Use personal contacts, Web search and review of journals or newsletters like "Great Lakes Wetlands" to help identify candidate sites. Conduct key informant interviews with local resource agency and/or appropriate NGO representatives. Secure copies of available research studies, design studies, etc. Conduct limited visits to nearby sites as applicable.

TABLE 9.1
GENERIC WORK PLAN

Task	Description of Approach	Data Sources/Comments
Develop and describe design concepts	Develop 2 to 4 generic design concepts in consultation with Technical Committee. Describe each concept in terms of: area and shape, conceptual design, general engineering and operating cost, development schedule, ecosystem potential, recreation potential, construction and recreation expenditures, displaced agricultural expenditures, non-use attributes (e.g. endangered species protection), etc.	Consultations with Technical and Local Committees, literature reviews, data compiled from comparable sites; select specific sites if appropriate to act as "templates" Concepts will vary in critical dimensions; e.g. proximity to shoreline and to NWA, one or two areas. Several scenarios need to be considered, for example: 1. Only marsh cells will be created (1,000 ac.) 2. Mostly marsh cells but with the inclusion of some marsh meadow and/or prairie habitats 3. Mostly marsh cells but with the inclusion of 50 ac. (20 ha) of marsh meadow and/or prairie habitats as well as 50 ac. (20 ha) of wooded swamp. Other location factors to be included in the analysis include broad location within the study area (i.e. north, central, south) and proximity to existing habitat features (e.g. patch size,dynamic benefits/effects).
Determine economic impacts	Identify and describe local agricultural and commercial impacts (no. and type of enterprise lost or gained activity levels, expenditure levels, etc.). Estimate economic multiplier impacts during construction and operations.	Primary information from key informants, comparable site studies, OMAFRA crop budgets, Statistics Canada small business profiles, Huron County Agriculture Economic Impact Study. Access MNR Input/Output model via client or apply economic base multipliers to determine multiplier effects.
Identify key values	Identify full range of impacted values and pre-screen to identify those that are likely to be most significant; decide which benefits are amenable to quantitative assessment; determine appropriate scales for evaluation (local, regional, continental).	Review results from background studies and consultations and compile a long list of candidate values for the site. Address valuation issues such as double counting. Identify possible indicators and measurement techniques for each value. Measurement may be quantitative or qualitative, quantitative assessments may be monetary or non-monetary.
Socio-eco. Methods	Summarize pertinent valuation data from the literature review and develop value coefficients for all key values using a benefit transfer framework.	See Appendix K for detailed description.
Ecosystem and biodiversity methods	Review ecosystem and biodiversity valuation models and develop an approach to assess environmental and ecosystem impacts.	Wetland classification system, rare/endangered species registry, assessment of ecosystem thresholds and constraints, hemispherical and regional, local implications.
Evaluate design concepts	Apply evaluation methods to each of the design concepts, summarize findings using impact matrix format.	The evaluation will include both economic and non economic effects/impacts (including impacts to agriculture, water resources, land use, economic development, etc.). Quantitative and qualitative assessments can be used. The level of detail and units of measurement will depend on available and most appropriate information and the relative importance of individual effects within the study area.
Revise, optimize, and screen concepts	Review results with technical committee and local project advisory committee. Identify methods to mitigate adverse impacts and to enhance positive values. Guide technical committee and local project advisory committee through a screening exercise to select a preferred concept.	Complete preliminary evaluations through discussion within the steering committee. Use unstructured or structured discussion approach in a workshop format for a broad audience to complete the evaluations.

9.2 Lessons Learned

The main insights gained through the research and analysis involved in this evaluation are summarized below. It is hoped that these insights will help facilitate the successful evaluation of future projects.

- The evaluation of proposed wetlands should not be attempted without the input and assistance of local people who are knowledgeable about social and economic activity and wildlife resources within their community.
- Public understanding and acceptance is most likely to be achieved if public input and participation begins early in the analysis, continues throughout the analysis, and offers participants an opportunity to give substantive input that can alter the direction of the work.
- Local input to the project was greatly facilitated and directed through the formal organization of a Local Advisory Committee (LAC). For this project the LAC:
  - Generated support for the project
  - Facilitated the dissemination of accurate information to the community
  - Identified potential points of concern in advance
  - Provided valuable local data that was used directly in the analysis
- An evaluation exercise for resource projects requires a well balanced study team with expertise in a variety of disciplines including ecology, engineering, economics, planning and geography.
- The outset consensus needs to be reached regarding the scope of the environmental effects to be investigated. A workshop involving all parties proved valuable in elaborating expectations, ideas, and perspectives, while providing a forum where consensus on study direction could be reached.
- Design parameters for the project should be elaborated prior to assessing the effects on biodiversity (i.e. species diversity). Again, a workshop proved useful in achieving consensus on restoration design parameters. Involving recognized authorities in developing or reviewing species lists helped to establish defensible conclusions as to effects of habitat restoration on species diversity.
- There is enough information in the research literature to permit a relatively detailed and realistic economic evaluation of wetland development proposals.
- The degree to which government funding is leveraged in the project, combined with the nature of a specific project, may trigger statutory environmental assessment requirements.

- The value of land appears to be the dominant cost factor for wetland development projects located in developed agricultural areas in Southern Ontario. This cost far outweighs the costs of on-site capital works.
- Facilities must be given the opportunity to collect user fees and retain resulting revenues if these facilities are to be operated on a self-sustaining basis.
- Operating costs can be recovered from user fee revenues, while still charging user fees that are quite modest relative to the cost of most commercial recreation.
- Wetland development projects can be designed and operated to successfully accommodate both consumptive and non-consumptive wildlife recreation activity.

It appears that the greatest public benefit associated with the use of wetland facilities will come from nature viewing, but, with regard to local heritage, waterfowl hunting is probably the most significant use.

10. Conclusions

As currently envisioned and assessed, the proposed Eastern Habitat Joint Venture (EHJV) wetland restoration project at Lake St. Clair would consist of the re-conversion of agricultural lands into a number of wetland habitat cells. While the design and management of the restoration project will focus primarily on maximizing benefits to migrating waterfowl, serious consideration is also being given to incorporating ancillary habitat types to complement the needs of other migratory and non-migratory species, including vulnerable, threatened and endangered flora and fauna. It is apparent that the incorporation of ancillary compatible habitats has the potential to increase biodiversity and socio-economic benefits of the project.

Public access to the site is deemed an important feature by the EHJV partners and the local citizens. Potential benefits to be realized from incorporating public access into the design include revenue generation from user fees and economic benefits to local and regional businesses.

10.1 Comparative Sites

A key step in the methodology of this project was to undertake a comparative analysis of other restored wetland sites.

Seven sites, located in Michigan, Ohio, New York, and Ontario, were selected for this analysis.

The comparative site analysis shows that restored wetlands generally have a minimum of 3 wetland cells, ranging in size from 3 acres to 1,300 acres (1 to 526 ha), with an average size of 300 acres (121 ha). A trade-off exists between the management advantages of a large cell and the potential for habitat diversity available with several cells. Comparative site analysis would support a minimum of 3 wetland cells, with the largest cell between 300 and 500 acres (121 and 202 ha) in size.

The site analysis suggests that the project site should be managed for more than waterfowl and wetland-dependent plants and animals. The restoration project of mudflats, wet meadows, wet forests and some upland habitat (e.g. prairie) would enhance the site's appeal to a range of recreational users.

Patterns of existing recreational use and comparative site analysis support the following estimates:

- Waterfowl hunting, 500 hunter-days
- Birding and nature viewing:

- 2,000 user-days with minimal facility development (some parking only) and little promotion
- 10,000 user-days with facility development (interpretive centre, parking, portable washrooms), habitat diversity, and promotion

The comparative site analysis suggests that existing local businesses gain some benefit from wetland users, but that there are limited opportunities for establishing businesses that are entirely dependent on the local spending of wetland users.

Comparative site analysis and experiences with the existing wetlands along the St. Clair shore suggest other impacts on adjacent landowners will be minimal.

10.2 Biological Evaluation

It has been estimated that three to seven million waterfowl migrate annually through the Great Lakes region.

Lake St. Clair is the second most important staging area for waterfowl along the Canadian shoreline of the Great Lakes with more than 8.6 million annual waterfowl use days (Spring and Fall combined). Peak numbers of waterfowl using the Lake St. Clair marshes are estimated at 60,000 and 150,000 in Spring and Fall, respectively. The marshes along the eastern shoreline of Lake St. Clair are the most important staging areas in southern Ontario for mallards, black ducks, Canada geese, and tundra swans. A large proportion of the North American population of canvasbacks and redheads also use the open water lake area for staging.

The addition of the EHJV wetland to the Lake St. Clair area should have a positive, albeit small, effect on the continental waterfowl population and on regional waterfowl populations. The principal value of the wetland for waterfowl will be the increase in available area for staging in the Spring and Fall. This additional staging area will benefit mostly dabbling ducks by maintaining or improving the birds fitness during migration.

Using Canadian Wildlife Service aerial survey records for dyked wetlands along the eastern shore of Lake St. Clair, the restored wetland could conservatively provide 318,000 dabbling duck days during Spring and Fall migration combined. Approximately 60 percent of the Spring use would be by dabblers other than mallards or black ducks, such as gadwalls, wigeons, shovellers, wood ducks, green-winged teal, and blue-winged teal. The inclusion of wooded swamp and tall grass prairie habitats should encourage other waterfowl species to breed at the site.

Based on breeding waterfowl surveys conducted by Ducks Unlimited Canada, waterfowl production could be as high as 0.85 ducks per acre, per year. If the restored wetland is highly managed, total waterfowl production from this site would be approximately 850 birds representing about 142 broods. Most of waterfowl produced would be mallards with only a few from other dabbler species and diving duck species (i.e. redheads or canvasbacks).

It is not known with certainty whether the restored wetland would simply redistribute waterfowl currently using the area or would generate additional waterfowl stopovers. Given the increase in waterfowl numbers in recent years, it is anticipated that additional wetland habitat will increase the number of migrating waterfowl using Lake St. Clair area as a stopover. McCullough (2000) predicts that in the short-term (i.e. 1 to 5 years) the wetland could redistribute birds within the Study Area. However, an increase in dabbler use over the entire Study Area is expected as the wetland becomes established (after approximately five years).

The restoration of wetlands in the Study Area would offer further opportunities for attracting and retaining additional waterfowl in the Fall under existing disturbance pressures. Hunting opportunities would not be compromised since the eventual result of the restoration project would be an increase in the number of waterfowl using the Study Area. Larger extents of wetlands would also benefit waterfowl during Spring migration and provide additional nesting areas.

Existing agricultural lands and drains in the Study Area have the potential of supporting 299 species of plants, butterflies, amphibians and reptiles, birds, and mammals taken as a group (termed 'total biota' in this report). Although this is a large number of species, many of these species are common throughout southern Ontario and do not reflect a high degree of habitat specialization. Total biota of existing agricultural fields and drains include one rare animal species and 13 rare plant species.

The Lake St. Clair shoreline has been identified as a Biodiversity Investment Area due to the large number of rare species found there. The Study Area, including Lake St. Clair, provides habitat for several species of plants, amphibians and reptiles, birds, and mammals (i.e. the King Rail, Least Bittern, Spotted Turtle and Spiny Softshell Turtle) that are considered rare and are listed as endangered, threatened or vulnerable by COSEWIC.

The proposed wetland restoration project has the potential of increasing the available habitat for species deemed significant because of their rarity in Ontario and Canada.

Of the proposed habitat types to be restored, the greatest number of species is associated with shallow marsh, followed by swamp, woodland, tall grass prairie, upland on the dykes, and mudflats. Shallow marsh also accounts for the greatest number of rare species, followed by tall grass prairie, swamp, and uplands on dykes. Shallow marsh contains by far the most species of animals (113), followed by swamp (67), woodland (63), existing agricultural lands and drains (59), the uplands of the dykes (45), tall grass prairie (39), and mudflats (13). Shallow marsh is also expected to contain the most native plant species (270), but the differences between some habitat types are less marked for plants than for animals. For example, existing agricultural lands and drains (211) and swamp (265) have almost the same number of plant species as shallow marsh. Tall grass prairie and uplands have noticeably fewer plant species (108 and 100 species, respectively).

Restoration of all of the proposed habitat types could more than double the total biota in the area to 804 species. Of the 534 additional species provided for by the restored habitat types, 135 are animals and 399 are plants. Twenty of the additional animal species and 39 of the plant species are considered rare. Of course, each of the various habitat types is associated with a group of species not found in any other habitat type. The shallow marsh and associated upland dykes, which will cover most of the restored area, will account for half (269 or 50 percent) of the new species. Swamps could add 91 (17 percent) additional species to the area and tall grass prairie could add 72 (14 percent). The remaining 102 species (19 percent) could be contributed through upland woodland habitat.

The greatest number of butterfly species are anticipated in shallow marsh, followed by the swamps, tall grass prairie, woodland, existing agricultural lands and drains, and scattered upland sites associated with the dykes. The restoration of shallow marsh and associated dykes will more than double the expected butterfly species in the area, from 13 species to 35. Forested swamps are expected to add only seven new species, while tall grass prairie could provide habitat for two additional species. Of the proposed habitat types, all of the five rare butterfly species would be associated with the shallow marsh and the dykes.

The greatest number of amphibian and reptile species is anticipated in shallow marsh, followed by the swamp, existing agricultural lands and drains, tall grass prairie and upland woodland. The restoration of shallow marsh will triple the expected amphibian and reptile species in the area. Three of these species are considered rare. The addition of further habitat types will add only one new reptile species associated with tall grass prairie.

The greatest number of breeding bird species is anticipated in shallow marsh, followed by existing agricultural lands and drains, uplands associated with the dykes, woodland, swamp and tall grass prairie. Migrant waterfowl species are most numerous in shallow marsh, followed by mudflats and existing agricultural lands and drains. The restoration of shallow marsh and the associated dykes could triple the number of new species of breeding birds in the area; nine of the additional species are considered rare. The restoration of additional habitat types will add only a few additional species of breeding birds to the area.

The restoration of shallow marsh and associated dykes is not expected to have a great influence on the number of mammal species that currently inhabit the area, and would result in the addition of only two additional mammal species to the area. However, the restoration of swamp would create habitat for an additional four additional mammal species.

As a general guiding principle, the proposed wetland should be located as close as possible to other wetlands, as well as to other habitat types, if the greatest number of species is to benefit. In terms of wetland location, there are a number of factors that should be considered including:

- Differences in vagility (i.e. dispersal capability) among species
- Existing barriers to dispersal for certain species (e.g. roadways, intensively cultivated agricultural lands)
- Species requirements for several different habitat types

Locating the proposed wetland close to other habitat types will also take advantage of existing species distribution in these habitat types.

The preferred location for the proposed wetland is close to existing coastal marshes, rather than dyked marshes. Since coastal marshes are older and reliant on the natural ecological processes associated with Lake St. Clair, they generally favour a greater number of desirable wetland species than dykes wetlands. Therefore, proximity to a coastal marsh would favour colonization of the restored wetland by desirable species, including many reptiles and amphibians.

10.3 Social Evaluation

A preliminary public consultation was undertaken by the EHJV partners in 1998. Following this consultation, a number of outstanding community issues and concerns were identified. The current study has addressed these concerns (see Section 8).

The proposed wetland restoration project will provide positive social benefits, primarily through the creation of new recreational opportunities for local residents. These opportunities will be available, to varying degrees, at all times of the year. Multi-use and public access are fundamental design and operation considerations for the restoration project. Local residents will be in close proximity to enjoy the many anticipated activities available at the site, as described in Section 4 (e.g. hunting, nature viewing, etc.). The presence of the new facility and the recreational opportunities that it will create, will add to the attractiveness of the area as a place to live and conduct business.

The EHJV partners are committed to an adaptive and inclusive management approach to the facility. This approach will be important to maximizing public benefits of the restored wetland environment.

The highest potential nuisance impacts that may develop in the future include trespassing, litter, noise, and parking/traffic issues. None of these issues were noted as being significant in the minds of local residents, either during this study or in the Phase I consultations, but were apparent at some of the comparative sites. Each of these potential impacts can be successfully mitigated with adequate pre-emptive site planning and future management of the site; therefore it is unlikely they will negatively impact the study area.

Existing hunt clubs could be impacted by the new wetland if it results in competition for hunters and/or competition for waterfowl. Competition for hunters is not expected to occur. The existing hunt clubs provide a higher cost hunting experience, featuring guided hunts and related services, that caters primarily to U.S. hunters. The new wetland will provide lower cost hunting opportunities to local hunters and will not provide services that compare to those of the existing camps. Therefore, it will not compete in the same market for high cost hunting experiences.

The greatest impact on existing hunt clubs will occur if the new wetland is located closer to existing clubs, entirely at the north or the south end of the study area. Impacts are minimized if the new wetland is split into two areas (one north, one south), if local bird populations increase because of the wetland, and if the wetland is hunted. However, location is not as important as management practices at the site. Since the proposed wetland will be hunted and will have a beneficial impact on local bird populations, impacts on existing hunt clubs are expected to be negligible.

A restored wetland in the EHJV project study area would be a very attractive opportunity for educators. If, for example, just one-quarter of the estimated existing environmentally-related school trips were to use the wetland project site, the results would be about 25 trips annually, involving about 600 students. This is four to five times the current use of the St. Clair National Wildlife Area. Interpretative signage and displays, and brochures would be a minimum requirement for educational use; the availability of a trained interpreter, on an appointment basis, would be a significant inducement to educational use

10.4 Economic Evaluation

The economic evaluation is based on the following criteria:

- Business Enterprise Performance – This criterion considers the potential to recover operating costs from operating revenues. Capital costs are not considered since these are recovered from other sources and not operating revenues.
- Net Economic Benefit –Total economic costs, including operating and capital costs, are compared to total benefits, including revenues plus user values to assess whether society as a whole gains or loses as a result of the completed restoration. The analysis of economic benefit uses two perspectives, a regional perspective encompassing the Municipality of Chatham-Kent and a provincial perspective.
- Change in Economic Activity – This indicator considers how the Provincial and regional economies are affected by changes in business sales associated with the facility. The analysis of economic impact uses two perspectives, a regional perspective encompassing the Municipality of Chatham-Kent and a provincial perspective. Changes in Regional and Provincial economic activity will occur due to losses in agricultural sales, increases in tourism business, and expenditures for land and capital works.

All of these various impacts have been evaluated. The net result indicates an overall loss of economic activity for the base case and the mud flats design options and a gain for the interpretive centre option. The annual change in economic activity, in all cases, is in the order of a few hundred thousand dollars or less (up to about a $350,000 loss for the base case option with a 3 percent interest rate). To put this loss in perspective, total annual income related to agricultural production in the Municipality of Chatham-Kent is in the order of $750 million.[6] The total impact, whether a gain or a loss, is therefore only one twentieth of 1 percent of total farm related income. Under a worst case scenario, which ignores gains from construction and the farm land sales, the loss is only one tenth of 1 percent of farm related income. Therefore, economic impacts on the regional economy are expected to be negligible.

Based on a willingness to pay (WTP) approach (see Section 7) the results from the literature suggest that user value is approximately $55/day for hunting, $25/day for birding and $14/day for general recreation. Using these figures, the restored wetland is expected to generate between $172,000 and $372,000 in use value.

Real estate values for farmland were evaluated in order to assess the likely cost of acquiring 1,000 acres (405 ha) for the project. This analysis indicates that there is, on average, a differential of $800 per acre between the price of land that will grow vegetable crops and land that is used for a typical corn/soybean rotation. The cost of acquiring the restoration project site will depend on its potential use for crop production and on the presence of farm buildings. The total cost of the site is expected to range from $3,700,000 to $4,500,000 and affect approximately five to eight farms.

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[6] This amount represents total valued added including direct, indirect and induced income effects and is based on an estimate of gross annual farm sales of $350 million.

Estimates of capital costs for facility development are presented separately for: a) construction of wetland cells, b) onsite buildings and ancillary facilities, and c) additional habitat.

The base case design assumes a 4 cell configuration and a base case wetland construction cost of $1.2 million. Costs of $1.0 and $1.4 million were used in variations of the base case design that featured fewer and more cells respectively.

Additional costs associated with the basic design include the cost of a building or buildings and the cost of additional dykes to go around residential properties that are retained. Additional dykes around residential properties are assumed to cost $23,000. The main onsite facility is assumed to be a central building to accommodate staff and provide space for volunteers. A basic 500-ft^2 facility would cost approximately $55,000 (at $110/ft^2) while a larger 3,000-ft^2 building with space for interpretive programs would cost approximately $330,000. An unheated 500-ft^2 work shed is included at $15,000 ($30/ft^2). Total building costs range from $70,000 to $345,000 depending on the configuration (see Section 4).

From the perspective of business performance, it appears that a restoration project including an additional mud flats habitat is the best option in terms of the highest expected net operating income and the lowest risk of loss. The assessment of net public benefit suggests that the inclusion of an interpretive centre has the highest net economic benefit, even after risk is taken into account. The interpretive centre option also shows the best performance in terms of impact on economic activity, with only a small chance that a loss in activity might occur with this.

These results imply that an optional business strategy would entail the initial development of the mud flats. If something resembling the interpretive centre is eventually desired because of the public benefits that it creates, then such a centre could be developed more gradually building on the experience and knowledge gained by running a more modest facility. Such an approach might also allow time to assess the impacts of increased use of the facility on the ecology of the wetland and the ecological benefits that are expected.

The combined environmental, economic, and social effects of the proposed project are positive and significant. The restored wetland will:

- Increase waterfowl staging habitat
- Increase local biodiversity
- Increase local hunting opportunities
- Increase local recreational opportunities
- Have a negligible economic effect
- Have positive public benefits
- Enhance local tourism potential
- Provide education and research opportunities
- Provide education and research
- Contribute to local cultural heritage
- Restore critical habitat within the Great Lakes ecosystem

The results of the analyses clearly suggest that the proposed wetland restoration project would provide substantial environmental and social benefits. They also suggest that the economic downside of the project is negligible and that there is a reasonable basis for expecting modest economic benefits. Accordingly, the EHJV partners and the Municipality of Chatham-Kent should consider moving forward with the initiative at the earliest opportunity.

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12. Acknowledgements

A study of this scope, comprehensiveness, and complexity could not have been successfully completed without the full and cooperative efforts of many individuals.

The Local Advisory Committee (LAC) provided an insightful and important local perspective on the study as it progressed. They contributed critical information that factored directly into the analysis. LAC members gave freely of their time, expertise, and advice at numerous meetings, presentations, and workshops. The members of the committee are: David Bradley, Larry Cornelis, Rex Crawford, Terry Jackson, Bob Lozon, Rosaire Lucier, Don Reaume, Maurice Sylvain, and Stan Vincent.

Several staff with the Municipality of Chatham-Kent also deserve considerable thanks. Ralph Pugliese, Senior Planner, and Irene Subocz, Director of Economic Development, met with several members of the Lake St. Clair Technical Committee when this project was being designed. Their enthusiastic support was both appreciated and essential. In addition, Gerry Murphy, Intermediate Planner, and Ron Anderson, Agricultural Co-ordinator, participated in many meetings and provided critical input and perspective in a number of areas.

The Lake St. Clair (LSC) Technical Committee is comprised of representatives of the Eastern Habitat Joint Venture (EHJV) partner organizations and is overseeing the long-term management of the LSC project. The committee complemented the expertise of the consulting team by providing guidance throughout the project and reviewing early drafts of this report. They also contributed technical expertise, both through their organizations and personally, to ensure that the best science was brought to bear on the analysis.

The Technical Committee was chaired by Kevin Loftus (MNR) and included the following individuals: Bob Clay (DU Canada), Brigitte Collins (CWS), Elaine Maerz (OMAFRA), Gary McCullough (CWS), Peter Roberts (OMAFRA), Owen Steele (DU Canada), and Ken Yaraskavitch (MNR). The experience, enthusiasm, and hard work of the Technical Committee was augmented by the participation of several key advisors who provided essential technical expertise on the socio-economic and biological fronts. Advisors for the project included: Katherine Elliot (MNR), Don Hector (MNR) and Douglass Legg (MEDTT). Important input on legislative matters was provided by Jim Boothby (MNR), Paul King-Fisher (MNR) and Derryk Renton (MNR).

Other individuals within the Ministry of Natural Resources contributed specific insight and technical information to the project. Special thanks go to Ken Abraham, Wasyl Bakowski, J.J. Beechie, Wilma Miyasaki, Don Sutherland, and Allen Woodliffe. Recognition should also go to John Haggeman, who manages the National Wildlife Area on Lake St. Clair and provided important statistics on the NWA site. Thanks should also be extended to Rick Haigh and Dave West with Ducks Unlimited for providing technical input and for reviewing early drafts of this report.

The following are members of the study team who contributed their skills, insight, and enthusiasm to the report:

Scott Duff	Project Manager	CH2M HILL Canada Limited
Mike Fortin	Economist	Consulting Economist
Stephen Monet	Biologist	Ecologistics Limited
Jason Culp	Research Technician	Ecologistics Limited
Reid Kreutzwiser	Comparative Sites/ Recreation Values	University of Guelph
Mike Bardecki	Comparative Sites/ Wetland Values	Ryerson Polytechnic Institute
Kerry Greenwood	Administrative Support	Ecologistics Limited

Additionally, a number of other individuals, both local and non-local, contributed to this report by participating in technical workshops (see Appendix D).

Finally, this study would not have been possible without the generous financial support of the following organizations: Ontario Ministry of Natural Resources, Canadian Wildlife Service, Ducks Unlimited Canada, Nature Conservancy of Canada, and Wildlife Habitat Canada.

APPENDIX A

Contact List for Comparative Site Analysis, Comparative Site Questionnaire

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*** These individuals were the primary interviewees for the comparative site analysis; the other interviewees provided supplemental information.**

Providing contacts and helping to identify candidate wetland sites:

Sheila Sleggs**,
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Ducks Unlimited Canada, Barrie, Ontario
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**** Interviewed by Kreutzwiser**

Providing comments on the draft comparative site questionnaire:

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Individuals contacted by Kreutzwiser requesting background information:

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Gary McCullough,
Canadian Wildlife Service, London, Ontario
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Comparative Site Questionnaire

Name: ______________________________

Title: ______________________________

Organization: ______________________________

____

Phone: (   ) ____________________

Fax: (   ) ____________________

E-mail: ____________________

Interviewer: ____________________ **Date of Interview:** ____________

Site Information

a. Name and location of the site. ______________________________

____

b. Please describe the land ownership of the site.

public ☐ private ☐ other ☐ specify ____________________

If joint ownership, please describe arrangements: ____________________

____

c. How would you classify your site?

recreation ☐ historical ☐ natural environment ☐ nature reserve ☐
waterway ☐ wilderness ☐ conservation area ☐ hunting reserve ☐
state/provincial park ☐ other ☐ specify ____________________

d. What is the total size of the site? ____________________

e. What is the total wetland area of the site? ____________________

f. What are the general management objectives and goals for the site? ____________

____

____

____

____

g. How would you describe the wetland? (e.g. natural, restored, dyked, etc. If a combination of these, what is dominant?) ____________________

h. How would you classify the wetland habitat? (e.g. marsh, open water, forested, etc. If a combination of these, what is dominant?) ____________________

Services/Facilities

a. Do you charge a daily fee to enter the site?

yes ☐ no ☐ If yes, how much? ____________________

b. Are there any restrictions to public use of the site?

yes ☐ no ☐ If yes, please describe. ____________________

c. What facilities and services are available onsite? (please check all that apply)

Facility/Services	**Availability**			**Fee (additional to entrance fee)**		
	yes	**no**	**Description**	**yes**	**no**	**$ amount**
interpretive tours/program						
hiking trails/boardwalk						
duck blind rentals						
marsh area leasing (e.g. to hunters)						
boat launch						
camp store						
campsites (overnight)						
fishing						
food concession						
school program						
interpretative/education centre						
trapping						
marina						
research program						
boat rentals						
swimming/beach area(s)						
public washrooms						
day use/picnic areas						
other (specify)						

d. One of the main purposes of this survey is to compare information on waterfowl populations throughout different wetland sites. Please answer the following questions in as much detail as possible.

e. Are wildlife and/or habitat management practices currently carried out within the site boundaries?

yes ☐ no ☐ If yes, please describe the practices. (e.g. water level manipulation, burning, nest boxes, trapping, exotic vegetation control, predator control, etc.)

f. What type(s) of waterfowl populations are found on the site, and what are the approximate number(s) of each? (please check all that apply)

Population Type	**Approx. Population Number**	
	Resident	**Migratory**
ducks		
geese		
swans		
management target species		
Total # of waterfowl		

g. What species do you manage the habitat for (if any)? ______________________

Operations and Management

a. Please provide your best approximation of the number of visitors to the site annually?

____

b. Please explain the main reason(s) why visitors are attracted to the site. (e.g. nature viewing, water fowl hunting, other hunting, camping, boating, school tours/programs, hiking trails/boardwalks, biking trails, swimming, fishing, etc.) ____________________

____

____

____

____

____

____

c. Which months are your busiest?

____

d. The next question is about the origin of your visitors.

What is the proportion of visitors from:

Nearby or local (within 30 min. drive)	%__________
Regional origins (drivel ½ hr to 2 hrs)	%__________
More distant origins (drive more than 2 hrs)	%__________

e. What are the average onsite expenditures by visitors coming to the site? (per visitor)

____

f. Do you use any of the following methods to advertise and promote the site?

Highway signs	yes ☐	no ☐
Newspaper ads	yes ☐	no ☐
Radio/TV ads	yes ☐	no ☐
Magazine ads	yes ☐	no ☐
Info in local tourism brochures	yes ☐	no ☐
Your own brochures	yes ☐	no ☐
Direct mailings	yes ☐	no ☐
Newsletter to past users/members	yes ☐	no ☐
Promotional contests or campaigns	yes ☐	no ☐

Other yes ☐ no ☐ Describe ____

g. What do you think is your most effective method(s) of promoting the site? __________

____

h. Are there any local businesses that depend on or benefit from visitors to your site?

yes ☐ no ☐ If yes, please describe. ______________________

____

____

If no, do you think there might be any local business development opportunities?

yes ☐ no ☐ If yes, please describe. ______________________

____

____

i. Do you receive complaints or hear of concerns about adverse impacts from residents or land owners within a 30-minute drive of the site? (i.e. litter, noise, traffic, trespassing, nuisance wildlife, crop damage, etc.)

yes ☐ no ☐ If yes, please specify. ______________________

____

____

What (if anything) is being done to address these concerns? ______________________

____

____

____

____

j. How many staff do you employ?

Staff	**#**	**Describe**
Full time equivalent		
Part time		
Seasonal		

k. Have any of the following types of studies been completed for the site?

user surveys ☐ visitor comments ☐ reports and studies related to use ☐
brochures/maps ☐ habitat/biodiversity ☐ economic impact ☐
other ☐ Specify ______________________

l. Do you keep a record/database of where your visitors come from? (i.e. hometown/state, etc.)

yes ☐ no ☐

m. If yes, might we be able to get a copy of the list? (We would only need a breakdown of numbers and origins.)

yes ☐ no ☐

n. Could you please describe the organizational or governance structure of the site? (e.g. operated by a government agency, non-profit corporation, private business, private association, etc.) Please Describe. ______________________________

____

____

o. What are your total revenues from the following sources? (If absolute dollars figures are not available, please offer a rough estimate or what percentage of your revenue is derived from each category.)

gate fees ______________

other user fees ______________

subsidies/grants ______________

other (describe) ______________ (e.g. sale of souvenirs, trapping revenue, etc.)

p. What is your total annual operating budget? (including costs for staff, equipment and supplies, repairs and maintenance, administration, advertising, etc. but not costs to service debt, to make major new investments or to build up capital reserves)

____

Thank You

NOTICE OF STUDY INITIATION

EHJV·PCHE
EASTERN HABITAT JOINT VENTURE
LE PLAN CONJOINT DES HABITATS DE L'EST
ONTARIO

Lake St. Clair Wetland Restoration Project

Socio-Economic and
Environmental Effects

The Lake St. Clair area has been identified by the Eastern Habitat Joint Venture (EHJV) as one of the top priority areas for habitat conservation for migrating waterfowl. The EHJV wants to restore 1,000 acres of wetland habitat within 8 kilometres of the eastern shore of Lake St. Clair. The proposal calls for a multiple use, public access wetland that will be developed over a 10-year time frame.

The Eastern Habitat Joint Venture (EHJV) is one of more than ten joint ventures established across the continent under the umbrella of the North American Waterfowl Management Plan (NAWMP). In Ontario, the EHJV is a partnership of seven organizations including the Ontario Ministry of Natural Resources, Ducks Unlimited Canada, the Canadian Wildlife Service, the Nature Conservancy of Canada, the Ontario Ministry of Agriculture, Food and Rural Affairs, Wildlife Habitat Canada, and Agriculture and Agri-food Canada.

A final decision to proceed with this project has not yet been made. First, EHJV wants to understand the socio-economic and environmental impacts of the proposed project. It has formed a project steering committee to investigate the proposal. A Local Advisory Committee (LAC) is meeting regularly with the project Steering Committee. The LAC will be a key local sounding board for the project. Volunteer members of the LAC represent a diverse range of local interests including, outfitters, agriculture, naturalists, business and municipal government.

A ***Socio-Economic and Environmental Effects Study*** is now underway. This study will identify the social, economic and environmental effects that the new wetland might have on the local community and beyond. The primary focus of the study is the local and regional community. This study has been initiated as a direct result of public input obtained in the spring of 1998.

The study is being conducted by a consulting team lead by Ecologistics Limited of Waterloo. Your input is welcomed and encouraged. There will be various opportunities for public input as the study progresses. In the meantime, if you have any questions about the socio-economic and environmental effects study, you may contact the researchers at 1-800-890-6543. If you wish to receive additional information about the project generally or want to be included on the project's mailing list please contact one of the following partners: Ken Yaraskavitch at the MNR office in Chatham (1-519-354-1779); Elaine Maerz at the OMAFRA Office in Ridgetown (1-519-674-1690); or Bob Clay or Owen Steel at the Ducks Unlimited Office in Barrie at (1-705-721-4444).[1]

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[1] This notice was run in the Saturday July 24th issue of the Chatham Daily News and the Chatham This Week issue from July 27th to August 2nd.

Lake St. Clair Wetland Restoration Project
Socio-Economic and Environmental Effects
HUNT CAMP OPERATOR INTERVIEW FORM

Any information that you provide will be treated as confidential.

1. As a hunt camp operator, what are your concerns or interests relating to the new marsh, for example:
    - Loss of your customers to the new site
    - Impacts on duck populations in your own marsh (describe)
    - New business opportunities for you with new marsh
    - Other concerns
2. Can you provide the following information describing your operation:
    - Name and location of camp:
    - The ownership of the marsh; is it a privately owned, owned by a private club, leased land:
    - The size of the marsh(es), the number of blinds:

- Uses of your marsh, for example hunting, fishing, trapping, other uses:

  ____

  ____

- Other services that you provide, for example guiding, cleaning birds, meals, rooms, …:

  ____

  ____

- Charge rates for your services (mourning hunt, afternoon hunt, daily or weekly rates, guiding, bird cleaning, overnight accommodation, …)

  ____

  ____

  ____

  ____

  ____

  ____

3. Please provide information below on the level of hunting activity on your marshes:

- On how many days of the season will you have hunters on your marshes:

Season	Total Days Open for Hunting this Year	Number of Days with Hunters on Your Marshes
Early season for Canada Geese	5	
Late season for Canada Geese	53	
Season for other waterfowl	74	

- What is the average number of hunters on your marshes each day during the season?

  On weekdays ____________________

  On weekends ____________________

- Approximately what is the total number of birds taken in a typical year? ________

- Could your marsh accommodate more hunters in a season now. YES ____ NO ____

  IF YES: what is limiting the number of hunters at your marsh now?

  Competition from other areas ____________________

  Not enough ducks and geese ____________________

  Need more blinds, better facilities ____________________

  Need more advertising and promotion ____________________

  Other ____________________

- What other activities—such as visiting local bars, buying supplies, and so on—do hunters regularly engage in when they are using your marsh?

  ____

  ____

- If your marsh is a private club, how many members are there? ________

  Is there a waiting list to join? YES _____ NO _____

- Where do your hunters come from?

  Percentage from local area (within ½ hour drive) ____________

  Percentage travelling ½ to 2 hours ____________

  From further away, travelling 2 hours or more ____________

  What is the percentage of hunters coming from the US ____________

4. Keeping in mind that the new marsh will be operated for public day use and not as a private camp, please answer the following questions about the likely level of use of a new marsh by hunters?

- Is there enough demand to justify a new public marsh? YES ____ NO ______

  Why do you think that this is the case? ____________________

  ____

  ____

  Do you think that a new public marsh will be used to full capacity ounce hunters learn about it?

  YES ____ NO ____

- Where do you think hunters will likely come from to use the new marsh?

  Percentage from the local area (within ½ hour drive) ______________

  Percentage from the region (travel ½ to 2 hours) ______________

  Further away (travel 2 hours or more) ______________

Lake St. Clair Wetland Restoration Project

Socio-Economic and Environmental Effects

FARM OPERATOR INTERVIEW FORM

1. As a farm, what are your concerns or interests relating to the new marsh, for example:

   - Crop destruction by geese

     ____

     ____

   - Interference with drainage or irrigation

     ____

     ____

   - loss of active farms, farm operators and farm land in the area

     ____

     ____

     ____

   - Loss of farm families in community

     ____

     ____

   - Effect on property values

     ____

     ____

   - Nuisance (traffic, trespassing, etc.)

     ____

     ____

   - Greater opportunity for locals to hunt

     ____

     ____

- New opportunity to lease fields to hunters

How would your concerns change, if at all, if the new marsh was right next to your farm?

2. Economic impact of the new marsh:

    - The crop mix near the lake appears to be about ½ corn and grain and ½ vegetables (1/4 tomatoes plus smaller amounts of onions, peppers, and other vegetables). Away from the lake, a corn/grain/soy bean rotation seems to be most common. Does this seem accurate based on your knowledge?
    - What is the most common rotation with vegetables?
    - With corn, grain and soy beans?
    - Could you look at our information on crop production costs and revenues and tell us if you think they are realistic for this area (the tables include only operating costs, not the costs for land or equipment)?

- Will loss of nearby farms or operators affect the economics of this operation (e.g. labour supply, shared implements)

  ____

  ____

- What percentage of your costs for the following items do you spend in Kent County:

  Seed, fertilizer, pesticides ________

  Fuel ________

  Hired labour ________

- Do you have a problem with geese damaging your crops? YES ____ NO ____

  IF YES, which crops and what is the impact on crop yields?

  ____

  ____

  ____

  ____

  ____

- How do you try to control geese, and what does this cost you (expenses and your time)?

  ____

  ____

  ____

  ____

  ____

Lake St. Clair Wetland Restoration Project
Socio-Economic and Environmental Effects
FARM OPERATOR TELEPHONE INTERVIEW FORM

1. As a farm, what are your concerns or interests relating to the new marsh (prompt re Crop destruction by geese, Interference with drainage or irrigation, loss of active farms, farm operators and farm land in the area, Loss of farm families in community, Effect on property values, Nuisance (traffic, trespassing, etc.), Greater opportunity for locals to hunt, New opportunity to lease fields to hunters, How would your concerns change, if at all, if the new marsh was right next to your farm?):

2. Economic impact of the new marsh:

    - The crop mix near the lake appears to be about ½ corn and grain and ½ vegetables (1/4 tomatoes plus smaller amounts of onions, peppers, and other vegetables). Away from the lake, a corn/grain/soy bean rotation seems to be most common. Does this seem accurate based on your knowledge?

    - What rotation are you using?

    - What is the most common rotation with vegetables?

With corn, grain and soy beans?

3. Crop production information (the tables include only operating costs, not the costs for land or equipment)?

	Yield/ac	Price	Cost/ac	Comment
Sugar Beets	19.4 t	56/t	$630	
Carrots	50,000 lb	$0.05/lb	$940	
Tomato – processing	55,000 lb 27.5 t	$0.06	$2,340	
Peppers	10,000 lb	$0.26	$1,820	
Grain Corn	137 bu	$3.60	$230	
W. Wheat	66 bu	$4.00	$160	
Soy Beans	43 bu	$9.20	$140	

	Yield/ac	Price	Cost/ac	Comment
Green Peas – processing	3,400 lb	$0.13	$200	

- What percentage of your costs for the following items do you spend in Kent County: __________

  Seed, fertilizer, pesticides __________
  Fuel __________
  Hired labour __________

- Do you have a problem with geese damaging your crops? YES ____ NO ____

  IF YES, which crops and what is the impact on crop yields? __________

  How do you try to control geese, and what does this cost you (expenses and your time)? __________

APPENDIX D

Biological Impact Workshop Attendance

Eastern Habitat Joint Venture
Lake St. Clair Wetland Restoration Project
Feasibility Study

Biological Impact Workshop Attendance
November 15, 1999, Guelph

Participant	Waterfowl Session	Biodiversity Session
Ken Abraham (OMNR)	Yes	Yes
Wasyl Bakowsky OMNR-NHIC	Yes	Yes
Mike Bardecki (study team)	Yes	Yes
J.J. Beechie OMNR	Yes	Yes
Dave Bradley LAC	Yes	No
Larry Cornelis LAC	No	Yes
Mike Fortin (study team)	Yes	Yes
John Haggeman CWS	Yes	Yes
Don Hector OMNR	Yes	Yes
Fred Johnson OMNR	Yes	No
Kevin Loftus OMNR	Yes	Yes
Bob Lozon LAC	Yes	No
Laurie Manard CWS	No	Yes
Gary McCullough CWS	Yes	Yes
Margaret McLaren OMNR	No	Yes
Steven Monet (study team)	Yes	Yes
Peter Roberts OMAFRA	Yes	Yes
Owen Steele DU	Yes	Yes
Don Surtherland OMNR	Yes	Yes
Stan Vincent LAC	Yes	No
Alan Woodliffe OMNR	No	Yes
Ken Yaraskavitch OMNR	yes	Yes

APPENDIX E

Study Area – Detailed Statistics

TABLE E.1
POPULATION AGE AND GENDER

Characteristics	Dover			Ontario		
Age of the Population	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Total number of persons	2,075	1,965	4,040	5,257,910	5,495,665	10,753,575
Age 0-4	130	145	275	376,730	357,440	734,170
Age 5-14	310	280	590	759,650	720,400	1,480,055
Age 15-19	165	155	320	357,765	340,240	698,000
Age 20-24	135	115	250	351,805	351,665	703,475
Age 25-54	905	850	1,750	2,389,390	2,474,590	4,863,980
Age 55-64	220	185	405	459,995	479,795	939,795
Age 65-74	150	155	295	362,500	430,970	793,470
Age 75 and over	65	85	155	200,070	340,560	540,635
Average age of the population	35.0	35.5	35.3	34.7	36.9	35.8
Percent of the population age 15 and over	79.0	78.3	78.5	78.3	80.3	79.4

Source: 1996 Census of Population

TABLE E.2
LANGUAGE

Characteristics	Dover			Ontario		
Languages(s) First Learned and Still Understood	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Total number of persons	2,080	1,960	4,040	5,257,905	5,495,665	10,753,575
English	1,480	1,430	2,910	3,831,560	3,994,210	7,825,770
French	340	280	620	208,850	232,820	441,675
Both English and French	100	95	200	36,520	40,215	76,735
Other languages (5)	155	160	315	1,180,975	1,228,425	2,409,395
Percent of population English is their first language			72.0			72.8
Percent of population French is their first language			15.3			4.1

Source: 1996 Census of Canada

TABLE E.3
EDUCATION

Characteristics	Dover			Ontario		
Highest Level of Schooling (age 15 and over)	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Total number of persons age 15 and over	1,630	1,545	3,180	4,080,940	4,348,270	8,429,215
Persons without a high school certificate	670	545	1,215	1,335,745	1,451,205	2,786,945
Persons with a high school certificate	285	265	550	535,500	693,775	1,229,275
Persons with some post secondary education (post secondary not completed)	175	110	285	452,745	491,050	943,795
Persons with trades or non-university certificate or diploma	400	465	865	1,024,130	1,024,830	2,048,950
Persons who have completed university	110	155	260	732,820	687,415	1,420,240

Source: 1996 Census of Canada

TABLE E.4
FAMILY CHARACTERISTICS

Selected Family Characteristics	Dover	Ontario
Number of married or common-law families	1,070	2,511,020
Average number of persons in married or common-law families	3.2	3.2
Average total income of married or common-law families ($)	69,222	64,434
Number of lone-parent families	80	421,700
Average number of persons in lone-parent families	2.8	2.6
Average total income of lone-parent families ($)	40,159	32,417

Source: 1996 Census of Canada

TABLE E.5
DWELLING CHARACTERISTICS

Selected Dwelling Characteristics	Dover	Ontario
Total number of private occupied dwellings	1,440	3,924,515
Number of owned private occupied dwellings	1,135	2,523,385
Number of rented private occupied dwellings	300	1,396,145
Average value of owned occupied dwellings ($)	153,312	177,410

Source: 1996 Census of Canada

TABLE E.6
LABOUR FORCE

Characteristics	Dover Township			Ontario		
Labour Force of the Population Age 15 and Older	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Average total income of persons reporting income ($)	35,919	19,976	28,370	33,599	21,048	27,309
Persons in the employed labour force	1,240	940	2,180	2,719,570	2,358,100	5,077,670
Persons reporting unpaid work	1,480	1,455	2,935	3,554,360	4,047,340	7,601,695
Persons reporting any hours of unpaid housework	1,430	1,435	2,870	3,463,790	4,003,695	7,467,485
Persons reporting any hours of unpaid child care	610	680	1,290	1,383,920	1,807,160	3,191,080
Persons reporting any hours of unpaid care to seniors	280	380	660	552,125	812,290	1,364,410
1996 unemployment rate (%)	6.1	6.0	6.0	8.7	9.6	9.1
1996 participation rate (%)	80.4	65.4	73.1	73.0	60.0	66.3

Source: 1996 Census of Canada

TABLE E.7
EMPLOYMENT

Characteristics	Dover Township			Ontario		
Industry Changes of the Population Age 15 and Over Who Have Worked Since January 1, 1995	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Total number of industries	1,310	995	2,305	2,894,315	2,507,085	5,401,400
Persons in agriculture and other resource-based industries (primary)	330	130	460	117,720	52,710	170,430
Persons in manufacturing and construction industries (secondary)	430	95	525	906,560	306,435	1,212,995
Persons in service industries (tertiary)	555	765	1,325	1,870,035	2,147,935	4,017,975

Source: 1996 Census of Canada

TABLE E.8
LAND TENURE

Location	1991	1996	Percent of Change	1996 Percent Township	1996 Percent County
Total Area in Agriculture (acres)					
Dover	73,220	73,676	0.6%		
Tilbury East	55,544	55,010	-1.0%		
Raleigh	63,038	63,818	1.2%		
Chatham	97,554	98,066	0.5%		
Kent County	568,088	584,765	2.9%		
Total Area Owned (acres)					
Dover	45,875	42,729	-6.9%	58.0%	7.3%
Tilbury East	35,186	37,012	5.2%	67.3%	6.3%
Raleigh	40,923	41,832	2.2%	65.5%	7.2%
Chatham	62,669	59,563	-5.0%	60.7%	10.2%
Kent County	386,784	396,668	2.6%		67.8%
Total Area Rent/Lease (acres)					
Dover	27,345	30,947	13.2	42.0%	5.3%
Tilbury East	20,358	17,998	-11.6	32.7%	3.1%
Raleigh	22,115	21,986	-0.6	34.5%	3.8%
Chatham	34,885	38,503	10.4	39.3%	6.6%
Kent County	181,304	188,097	3.7%		32.2%

TABLE E.9
CROP LAND AREA

Location	1991	1996	Percent of Change	1996 Percent Township	1996 Percent County
Area Land in Crops (acres) (excludes Christmas trees)					
Dover	67,406	67,522	0.2%	91.6%	11.5%
Tilbury East	54,343	51,511	-5.2%	93.6%	8.8%
Raleigh	60,611	59,077	-2.5%	92.6%	10.1%
Chatham	91,990	91,123	-0.9%	92.9%	15.6%
Kent County	524,250	528,602	0.8%		90.4%
Area Irrigated (acres)					
Dover	726	1,359	87.2%	1.8%	0.2%
Tilbury East	270	230	-14.8%	0.4%	0.0%
Raleigh	503	1,128	124.3%	1.8%	0.2%
Chatham	607	227	-62.6%	0.2%	0.0%
Kent County	3,081	4,166	35.2%		0.7%

TABLE E.10
FARM OPERATING ARRANGEMENTS

Location	1991	1996	Percent of Change	1996 Percent Township	1996 Percent County
Total Number of Farms					
Dover	339	331	-2.4%		12.0%
Tilbury East	237	221	-6.8%		8.0%
Raleigh	330	308	-6.7%		11.0%
Chatham	513	467	-9.0%		17.0%
Kent County	2,822	2,690	-4.7%		
Farms – Sole Proprietorship					
Dover	126	176	39.7%	53.0%	7.0%
Tilbury East	217	133	-38.7%	60.0%	5.0%
Raleigh	321	186	-42.1%	60.0%	7.0%
Chatham	208	259	24.5%	55.0%	10.0%
Kent County	1,681	1,535	-8.7%		57.0%
Farms – With Partnership					
Dover		91		27.0%	3.0%
Tilbury East		67		30.0%	2.0%
Raleigh		86		28.0%	3.0%
Chatham		142		30.0%	5.0%
Kent County		811			30.0%

TABLE E.11
GROSS FARM RECEIPTS

Location	1991	1996	Percent of Change	1996 Percent Township	1996 Percent County
Total # of Farms					
Dover	339	331	-2.4%		12.0%
Tilbury East	237	221	-6.8%		8.0%
Raleigh	330	308	-6.7%		11.0%
Chatham	513	467	-9.0%		17.0%
Kent County	2,822	2,690	-4.7%		
Under $2,500 Farms Reporting					
Dover	10	6	-40.0%	1.8%	0.2%
Tilbury East	2	2	0.0%	0.9%	0.1%
Raleigh	10	6	-40.0%	1.9%	0.2%
Chatham	14	12	-14.3%	2.6%	0.4%
Kent County	99	86	-13.1%		3.2%

TABLE E.11
GROSS FARM RECEIPTS

Location	1991	1996	Percent of Change	1996	
				Percent Township	Percent County
$2,500 – $4,999 Farms Reporting					
Dover	5	3	-40.0%	0.9%	0.1%
Tilbury East	5	6	20.0%	2.7%	0.2%
Raleigh	13	5	-61.5%	1.6%	0.2%
Chatham	13	2	-84.6%	0.4%	0.1%
Kent County	73	56	-23.3%		2.1%
$5,000 – $9,999 Farms Reporting					
Dover	16	12	-25.0%	3.6%	0.4%
Tilbury East	13	10	-23.1%	4.5%	0.4%
Raleigh	28	17	-39.3%	5.5%	0.6%
Chatham	32	17	-46.9%	3.6%	0.6%
Kent County	167	127	-24.0%		4.7%
$10,000 – $24,999 Farms Reporting					
Dover	56	45	-19.6%	13.6%	1.7%
Tilbury East	32	31	-3.1%	14.0%	1.2%
Raleigh	60	46	-23.3%	14.9%	1.7%
Chatham	74	67	-9.5%	14.3%	2.5%
Kent County	447	395	-11.6%		14.7%
$25,000 – $49,999 Farms Reporting					
Dover	74	69	-6.8%	20.8%	2.6%
Tilbury East	55	42	-23.6%	19.0%	1.6%
Raleigh	60	71	18.3%	23.1%	2.6%
Chatham	114	82	-28.1%	17.6%	3.0%
Kent County	608	506	-16.8%		18.8%
$50,000 – $99,999 Farms Reporting					
Dover	73	45	-38.4%	13.6%	1.7%
Tilbury East	63	31	-50.8%	14.0%	1.2%
Raleigh	83	46	-44.6%	14.9%	1.7%
Chatham	105	67	-36.2%	14.3%	2.5%
Kent County	611	395	-35.4%		14.7%
$100,000 – $249,999 Farms Reporting					
Dover	75	69	-8.0%	20.8%	2.6%
Tilbury East	56	42	-25.0%	19.0%	1.6%
Raleigh	51	71	39.2%	23.1%	2.6%
Chatham	94	82	-12.8%	17.6%	3.0%
Kent County	548	506	-7.7%		18.8%

TABLE E.11
GROSS FARM RECEIPTS

Location	1991	1996	Percent of Change	1996	
				Percent Township	Percent County
$250,000 – $499,999 Farms Reporting					
Dover	20	33	65.0%	10.0%	1.2%
Tilbury East	11	11	0.0%	5.0%	0.4%
Raleigh	19	25	31.6%	8.1%	0.9%
Chatham	46	56	21.7%	12.0%	2.1%
Kent County	203	262	29.1%		9.7%
$500,000 and Over Farms Reporting					
Dover	10	16	60.0%	4.8%	0.6%
Tilbury East	0	2	200.0%	0.9%	0.1%
Raleigh	6	9	50.0%	2.9%	0.3%
Chatham	21	27	28.6%	5.8%	1.0%
Kent County	72	112	55.6%		4.2%

TABLE E.12
VEGETABLE CROPS

Location	1991	1996	Percent of Change	1996	
				Percent Township	Percent County
Total Area of Vegetables (acres)					
Dover	6,965	6,064	-12.9%	8.2%	1.0%
Tilbury East	1,539	200	-87.0%	0.4%	0.0%
Raleigh	1,813	1,566	-13.6%	2.5%	0.3%
Chatham	6,862	6,204	-9.6%	6.3%	1.1%
Kent County	23,724	21,570	-9.1%		3.7%
Sweet Corn (acres)					
Dover	815	-	-	-	-
Tilbury East	29	26	-10.3%	0.0%	0.0%
Raleigh	-	-	-	-	-
Chatham	379	222	-41.4%	0.2%	0.2%
Kent County	2,570	1,479	-42.5%		0.3%
Tomatoes (acres)					
Dover	2,894	3,475	20.1%	4.7%	0.6%
Tilbury East	140	5	-96.4%	0.0%	0.0%
Raleigh	1,059	632	-40.3%	1.0%	0.1%
Chatham	5,064	4,620	-8.8%	4.7%	4.7%
Kent County	12,298	12,049	-2.0%		2.1%

TABLE E.12
VEGETABLE CROPS

Location	1991	1996	Percent of Change	1996	
				Percent Township	Percent County
Cucumbers and Gherkins (acres)					
Dover	58	53	-8.6%	0.1%	0.0%
Tilbury East	48	-	-	-	-
Raleigh	46	45	-2.2%	0.1%	0.0%
Chatham	297	167	-43.8%	0.2%	0.0%
Kent County	639	427	-33.2%		0.1%
Green Peas (acres)					
Dover	2,565	1,339	-47.8%	1.8%	0.2%
Tilbury East	372	-	-	-	-
Raleigh	411	390	-5.1%	0.6%	0.1%
Chatham	732	727	-0.7%	0.7%	0.1%
Kent County	4,612	4,304	-6.7%		0.7%
Carrots (acres)					
Dover	-	641	-	0.9%	0.1%
Tilbury East	97	77	-20.6%	0.1%	0.0%
Raleigh	0	0	-	0.0%	0.0%
Chatham	-	0	-	0.0%	0.0%
Kent County	391	862	120.5%	0.1%	0.1%
Peppers (acres)					
Dover	87	97	11.5%	0.1%	0.0%
Tilbury East	8	2	-75.0%	0.0%	0.0%
Raleigh	20	37	85.0%	0.1%	0.0%
Chatham	267	347	30.0%	0.4%	10.0%
Kent County	479	627	30.9%		0.1%

TABLE E.13
VALUE OF MACHINERY AND EQUIPMENT

Location	1991	1996	Percent of Change	Percent County (1996)
Total Value – Mach. and Equip. ($)				
Dover	34,823,104	43,054,032	23.6%	13.9%
Tilbury East	25,382,360	27,853,833	9.7%	9.0%
Raleigh	27,146,224	31,840,043	17.3%	10.3%
Chatham	52,635,010	61,131,675	16.1%	19.8%
Kent County	257,003,338	309,470,294	20.4%	

TABLE E.14
FARM VALUE AND CAPITAL EXPENDITURES

Location	1991	1996	Percent of Change	Percent County (1996)
Total Farm Capital ($)				
Dover	220,452,028	294,358,108	33.5%	14.2%
Tilbury East	124,117,620	153,846,498	24.0%	7.4
Raleigh	165,740,688	215,151,620	29.8%	10.4%
Chatham	309,874,610	394,286,130	27.2%	19.1%
Kent County	1,511,789,004	2,068,326,064	36.8%	
Total Value Land/Buildings ($)				
Dover	184,429,798	250,689,138	35.9%	14.6%
Tilbury East	98,226,153	125,470,309	27.7%	7.3
Raleigh	137,245,413	181,555,007	32.3%	10.6%
Chatham	251,418,778	327,513,883	30.3%	19.0%
Kent County	1224619182	1,720,028,760	40.5%	
Total Value Mach. and Equip. ($)				
Dover	34,823,104	43,054,0322	3.6%	
Tilbury East	25,382,360	27,853,833	9.7%	
Raleigh	27,146,224	31,840,0431	7.3%	
Chatham	52,632,010	61,131,6751	6.1%	
Kent County	257,003,338	309,470,294	20.4%	
Value of Livestock and Poultry ($)				
Dover	1,199,126	614,938	-48.7%	1.5%
Tilbury East	509,107	522,356	2.6%	1.3
Raleigh	1,349,051	1,756,570	30.2%	4.5%
Chatham	5,820,822	5,640,572	-3.1%	14.5%
Kent County	30,166,484	38,827,6102	8.7%	
Total Purchases Capital Assets – Farms Reporting				
Dover		156		12.2%
Tilbury East		120		9.4
Raleigh		125		9.8%
Chatham		229		17.9%
Kent County		1,280		
Total Purchases Capital Assets ($)				
Dover		7,680,688		11.3%
Tilbury East		5,508,189		8.1
Raleigh		5,856,855		8.6%
Chatham		13,026,727		19.2%
Kent County		67,849,329		

APPENDIX F

Key Features of the Wetland Restoration Projects

	Hullett Marsh Provincial Wildlife Area, Ontario	**Tiny Marsh Provincial Wildlife Area, Ontario**	**Hilliardton Provincial Wildlife Area, Ontario**	**St. John's Marsh Wildlife Area, Michigan**	**Ottawa Wetland Complex, Ohio**	**Pickeral Creek Wildlife Area, Ohio**	**Montezuma Wetland Complex, New York**
Total Size	5,200 ac. (2,104 ha)	2,300 ac. (931 ha)	1,790 ac. (724 ha)	2,500 ac. (1,012 ha)	8,250 ac. (3,339 ha) total: 5,600 ac. (2,266 ha) Ottawa Refuge 650 ac. (263 ha) Metzger Marsh 2,000 ac.(809 ha) Magee Marsh	3,000 ac. (1,214 ha)	36,000 ac. (14,569 ha) total: 7,068 ac. (2,860 ha) Montezuma NWR 7,657 ac. (3,098 ha) N. Montezuma WMA Balance mostly private land
Wetland area	1,680 ac. (680 ha) mostly dyked marsh	1,400 ac. 567 ha) dyked marsh	506 ac. (205 ha) dyked marsh, swamp, bog and fen	1,700 ac. (688 ha) coastal marsh 200 ac. (81 ha) dyked marsh	4,860 ac. (1,967 ha) dyked marsh + 200 ac. (81 ha) natural marsh Ottawa Refuge 620 ac. (251 ha) dyked marsh Metzger Marsh 1,800 ac. (728 ha) dyked marsh Magee Marsh	2,000 ac. (809 ha) dyked marsh	3,600 ac. (1,457 ha) dyked marsh in Montezuma Refuge 5,360 ac. (2,169 ha) dyked marsh in N. Montezuma WMA
Number/size of wetland cells	3 cells	3 cells	4 cells totalling 506 ac. (205 ha)	3 cells, 8 to 106 ac. (3 to 43 ha) in size	25 cells, 60 to 500 ac. (24 to 202 ha) Ottawa Refuge 1 cell (620 ac. (251 ha)) Metzger Marsh 10 cells Magee Marsh	30 cells, 25 to 300 ac. (10 to 121 ha) in size	9 cells, 5 to 1,300 ac. (2 to 526 ha) in Montezuma Refuge Numerous cells, from 5 to 80 ac. (2 to 32 ha) in N. Montezuma WMA
	Hullett Marsh Provincial Wildlife Area, Ontario	Tiny Marsh Provincial Wildlife Area, Ontario	Hilliardton Provincial Wildlife Area, Ontario	St. John's Marsh Wildlife Area, Michigan	Ottawa Wetland Complex, Ohio	Pickeral Creek Wildlife Area Ohio	Montezuma Wetland Complex, New York
Year established	1967; dyked in 1967	1967; dyked in 1980	1996	1988	1961	1992	1930s; restoration on-going
Ownership	Provincial, Ducks Unlimited Canada	Provincial	Provincial, Ducks Unlimited Canada	State	Federal and state	State	Federal, state, private
Activities	Waterfowl, upland game, and deer hunting, dog trials, hiking, canoeing,	Waterfowl, small game, deer, and pheasant hunting, school pro-	Waterfowl hunting, nature viewing, school programs, research	Viewing, fishing, hunting, trapping, education	Same as St. John's + auto tours, Swimming, boating	Same as St. John's	Same as St. John's + wildlife drive

	Hullett Marsh Provincial Wildlife Area, Ontario	Tiny Marsh Provincial Wildlife Area, Ontario	Hilliardton Provincial Wildlife Area, Ontario	St. John's Marsh Wildlife Area, Michigan	Ottawa Wetland Complex, Ohio	Pickeral Creek Wildlife Area, Ohio	Montezuma Wetland Complex, New York
	bird watching, nature trails, school tours	grams, hiking, nature trails	projects				
Facilities	Boat launch, hiking trails, interpretative programs, school program, public washrooms, picnic area	Hiking trails, boat launch, interpretative center, public washrooms, school program	Hiking trails, boat launch, information kiosk, school program	Boat launch, canoeing	Nature centre, boardwalk, blind rental, observation tower, boat launch, picnic area	Observation tower	Nature centre, observation tower, boat launches, picnic area
Total annual visitation	Approx. 5,000	10 to 12,000	Approx. 1,000	10,000+	115,000 Ottawa Refuge 100,000 Magee Marsh	Approx. 16,000	139,500 Montezuma Refuge 2,500 N. Montezuma WMA
	Hullett Marsh Provincial Wildlife Area, Ontario	Tiny Marsh Provincial Wildlife Area, Ontario	Hilliardton Provincial Wildlife Area, Ontario	St. John's Marsh Wildlife Area, Michigan	Ottawa Wetland Complex, Ohio	Pickeral Creek Wildlife Area, Ohio	Montezuma Wetland Complex, New York
Percent local visitors	15%	50%	50%	80%	50% Ottawa Refuge 40% Magee Marsh	70%	30% Nontezuma WMA 70% N. Montezuma WMA
Local dependent businesses	Local hotels, restaurants, gas stations, outdoor sports shops	Bluewater Interpreters, pheasant hunt services	Local hotels, restaurants, tourist operators	Bait/tackle, canoe rental, restaurants, gas stations	2 - Campgrounds nearby, restaurants, gas stations, motels	1 restaurant, 1 private campground	Numerous businesses in a half dozen nearby communities
Staff	2 part-time	1 part-time	None	1.5 FTE, 1 seasonal	8.5 FTE, 9 seasonal Ottawa NWR 4.5 FTE, 1 seasonal Magee WA	3.5 FTE, 3 seasonal	8.2 FTE, 1 seasonal in Montezuma NWR 1.5 FTE, 1 seasonal in N. Montezuma WMA
Budget	Approx. Cdn$30,000	Approx. Cdn $12,000	N/A	US $80,000	US $640,000 Ottawa NWR US $200,000 Magee WA	N.A.	US $600,000 Montezuma NWR US $100,000 N. Montezuma WMA

Appendix G - List of Fauna Likely to Inhabit the Proposed Habitat Types

	Rarity Designations			Proposed Habitat Types										
	COSEWIC[5]	NHIC[6]	Kent County[7]	Existing Agricultural Lands and Drains	Shallow Marsh	Scattered Upland Stands of Trees, Shrubs, and Grasses	Mudflats	Swamp		Tall Grass Prairie	Upland Woodland		Cumulative Totals	Cumulative Rare
					(large blocks)		(50 acres)	Thicket Swamp	Treed Swamp	20 acres	(20 acres)			
								(10 acres)	(10 acres)					
Butterflies[7]														
Silver Spotted Skipper *Epargyreus clarus*						x				x	x		3	
Southern Cloudywing *Thorybes bathyllus*		S3	UK			x				x			3	3
Dreamy Duskywing *Erynnis icelus*						x		x	x	x	x		3	
Juvenal's Duskywing *Erynnis jevenalis*											x		7	
Common Sootywing *Pholisora catullus*			UK							x			6	
Least Skipperling *Ancyloxypha numitor*			UK		x								2	
Peck's Skipper *Polites coras*			UK	x	x					x			1	
Tawny-edged Skipper *Polites themistocles*			UK	x	x					x			1	
Long Dash *Polites mystic*					x				x	x			2	
Northern Broken Dash *Wallengrenia egeremet*			UK			x				x			3	
Delaware Skipper *Atrytone logan*			UK		x					x			2	
Mulberry Wing *Poanes massasoit*		S3	?		x								2	2
Hobomok Skipper *Poanes hobomok*						x		x	x				3	
Broad-winged Skipper *Poanes viator*			UK		x								2	
Dion Skipper *Euphyes dion*			UK		x			x	x				2	
Black Dash *Euphyes conspicuus*			UK		x								2	
Two-spotted Skipper *Euphyes bimacula*		S3S4	UK		x								2	2
Dun Skipper *Euphyes vestris*					x								2	
Black Swallowtail *Papilio polyxenes*			UK	x	x								1	
Tiger Swallowtail *Papilio glaucus*									x		x		5	
Spicebush Swallowtail *Papilio troilus*									x		x		5	
Clouded Sulphur *Colias philodice*				x	x					x			1	
Bronze Copper *Lycaena hyllus*					x								2	
American Copper *Lycaena phlaeas*			UK	x	x								1	
Acadian Hairstreak *Satyrium acadicum*			UK					x					5	

	Rarity Designations			Proposed Habitat Types										
	COSEWIC[5]	NHIC[6]	Kent County[7]	Existing Agricultural Lands and Drains	Shallow Marsh	Scattered Upland Stands of Trees, Shrubs, and Grasses	Mudflats	Swamp		Tall Grass Prairie	Upland Woodland		Cumulative Totals	Cumulative Rare
					(large blocks)		(50 acres)	Thicket Swamp (10 acres)	Treed Swamp (10 acres)	20 acres	(20 acres)			
Banded Hairstreak *Satyrum calanus*			UK								x		7	
Hickory Hairstreak *Satyrum caryaevorum*		S3	UK								x		7	7
Gray Hairstreak *Strymon melinus*		S3	RK			x				x			3	3
Spring Azure *Celastrina argiolus*											x		7	
Great Spangled Fritillary *Speyeria cybele*				x	x					x			1	
Aphrodite Fritillary *Speyeria aphrodite*			UK							x			6	
Meadow Fritillary *Boloria bellona*			UK	x	x								1	
Northern Pearl Crescent *Phyciodes pascoensis*					x					x	x		2	
Tawny Crescentspot *Phyciodes batesii*		S3	UK							x			6	6
Question Mark *Polygonia interrogationis*						x			x		x		3	
Mourning Cloak *Nymphalis antiopa*				x		x		x	x		x		1	
Milbert's Tortoise Shell *Nymphalis milberti*					x								2	
American Painted Lady *Vanessa virginiensis*			UK	x	x					x			1	
Red Admiral *Vanessa atalanta*				x	x	x		x	x		x		1	
White Admiral *Limenitis arthemis*						x					x		3	
Northern Pearly Eye *Enodia anthedon*			RK						x				5	
Northern Eyed Brown *Satyrodes eurydice*			UK		x								2	
Appalachian Eyed Brown *Satyrodes appalachia*			UK					x	x				5	
Little Wood Satyr *Megisto cymela*									x	x	x		5	
Wood Nymph *Cercyonis pegala*									x	x	x		5	
Monarch *Danaus plexippus*	VUL			x	x	x				x			1	1
***Amphibians and Reptiles*[7]**														
Mudpuppy					x								2	
American Toad				x	x								1	
Western Chorus Frog					x			x	x				2	
Northern Leopard Frog				x	x			x					1	
Green Frog					x			x					2	
Bullfrog					x								2	
Common Snapping Turtle				x	x			x	x				1	
Midland Painted Turtle				x	x			x	x				1	
Blanding's Turtle					x				x				2	
Spotted Turtle	VUL	S3			x								2	2
Eastern Spiny Softshell Turtle	THR	S3			x								2	2
Eastern Fox Snake		S3		x	x					x			1	1
Northern Water Snake					x			x	x				2	

	Rarity Designations			Proposed Habitat Types										
	COSEWIC[5]	NHIC[6]	Kent County[7]	Existing Agricultural Lands and Drains	Shallow Marsh	Scattered Upland Stands of Trees, Shrubs, and Grasses	Mudflats	Swamp		Tall Grass Prairie	Upland Woodland		Cumulative Totals	Cumulative Rare
					(large blocks)		(50 acres)	Thicket Swamp	Treed Swamp	20 acres	(20 acres)			
								(10 acres)	(10 acres)					
Brown Snake					x					x	x		2	
Eastern Garter Snake				x	x	x				x	x		1	
Butler's Garter Snake		S2								x			6	6
Eastern Smooth Green Snake										x	x		6	
Birds[3]														
Pied-billed Grebe			Rare		B								2	
American Bittern			Rare		B								2	
Least Bittern	VUL	S3	Rare		B								2	2
Great Blue Heron			Rare	F	F								2	
Great Egret		S2	Very Rare		F								1	
Green Heron			Uncommon	B	B			B					1	
Black-crowned Night Heron		S3	Rare		F								2	
Tundra Swan					M								2	
Canada Goose					B								2	
Snow Goose					M								2	
Wood Duck					B				B				2	
Green-winged Teal			Rare		B								2	
American Black Duck			Rare		B								1	
Mallard				B	B					B			2	
Northern Pintail			Rare		B								2	
Blue-winged Teal					B					B			2	
Northern Shoveler		S3	Rare		B					B			2	2
Gadwall			Rare		B								2	
American Widgeon			Rare		B								2	
Canvasback		S1	Very Rare		B								2	2
Redhead		S2	Rare		B								2	2
Ring-necked Duck					M								2	
Greater Scaup					M								2	
Lesser Scaup					M								2	
Common Goldeneye					M								2	
Bufflehead					M								2	
White-winged Scoter					M								2	
Hooded Merganser					M				B				2	
Common Merganser					M								2	
Red-breasted Merganser					M								2	
Ruddy Duck			Rare		B								2	
Northern Harrier			Uncommon		B					B			2	
Red-tailed Hawk									B		B		5	
American Kestrel				B		B							1	
King Rail	END	S2	Very Rare		B								2	2
Virginia Rail			Rare		B								2	
Sora			Rare		B								2	
Common Moorhen			Rare		B								2	
American Coot			Rare		B								2	
Black-bellied Plover					M		M						2	
Semipalmated Plover					M		M						2	
Killdeer				B	B		M						1	
Greater Yellowlegs				M	M		M						1	
Lesser Yellowlegs				M	M		M						1	
Solitary Sandpiper				M	M		M						1	
Spotted Sandpiper				B	B		M						1	
Ruddy Turnstone					M		M						2	
Semipalmated Sandpiper					M		M						2	
Least Sandpiper					M		M						2	
Pectoral Sandpiper					M		M						2	
Dunlin					M		M						2	
Short-billed Dowitcher					M		M						2	
Common Snipe			Rare		B								2	
American Woodcock								B					5	

	Rarity Designations				Proposed Habitat Types									
	COSEWIC[5]	NHIC[6]	Kent County[7]	Existing Agricultural Lands and Drains	Shallow Marsh	Scattered Upland Stands of Trees, Shrubs, and Grasses	Mudflats	Swamp		Tall Grass Prairie	Upland Woodland		Cumulative Totals	Cumulative Rare
					(large blocks)		(50 acres)	Thicket Swamp	Treed Swamp	20 acres	(20 acres)			
								(10 acres)	(10 acres)					
Forster's Tern		S3			B								2	2
Black Tern			Rare		B								2	
Rock Dove				B									1	
Mourning Dove				B		B					B		1	
Black-billed Cuckoo						B			B		B		3	
Yellow -billed Cuckoo						B			B		B		3	
Eastern Screech-owl						B			B		B		3	
Great-horned Owl						B					B		3	
Ruby-throated Hummingbird									B		B		5	
Belted Kingfisher					B								2	
Red-headed Woodpecker	VUL		Uncommon			B			B				3	3
Downy Woodpecker				B		B					B		1	
Hairy Woodpecker									B		B		5	
Northern Flicker				B		B			B				1	
Eastern Wood-pewee									B		B		5	
Willow Flycatcher								B					5	
Great Crested Flycatcher									B		B		5	
Eastern Kingbird				B		B			B				1	
Horned Lark				B						B			1	
Purple Martin					B								2	
Tree Swallow				B	B								1	
Northern Rough-winged Swallow					B								2	
Bank Swallow					B								2	
Barn Swallow				B	B								1	
Blue Jay				B		B					B		1	
American Crow				B		B					B		1	
Black-capped Chickadee			Uncommon	B		B		B	B		B		1	
White-breasted Nuthatch				B		B			B		B		1	
House Wren				B		B					B		1	
Carolina Wren		S3	Rare			B							3	3
Marsh Wren			Rare		B								2	
Blue-gray Gnatcatcher									B		B		7	
Veery											B		7	
Wood Thrush											B		7	
American Robin				B		B					B		1	
Gray Catbird						B					B		3	
Cedar Waxwing						B					B		3	
Yellow-throated Vireo											B		7	
Red-eyed Vireo						B			B		B		3	
Warbling Vireo				B		B			B		B		1	
Yellow Warbler				B		B		B					1	
American Redstart											B		7	
Mourning Warbler								B					5	
Common Yellowthroat				B	B			B					1	
Northern Cardinal				B		B					B		1	
Rose-breasted Grosbeak											B		7	
Eastern Towhee						B					B		3	
Chipping Sparrow				B		B							1	
Field Sparrow										B			6	

	Rarity Designations			Proposed Habitat Types										
	COSEWIC[5]	NHIC[6]	Kent County[7]	Existing Agricultural Lands and Drains	Shallow Marsh	Scattered Upland Stands of Trees, Shrubs, and Grasses	Mudflats	Swamp		Tall Grass Prairie	Upland Woodland		Cumulative Totals	Cumulative Rare
					(large blocks)		(50 acres)	Thicket Swamp	Treed Swamp	20 acres	(20 acres)			
								(10 acres)	(10 acres)					
Vesper Sparrow				B						B			1	
Savannah Sparrow										B			6	
Song Sparrow				B		B					B		1	
Swamp Sparrow			Uncommon		B								2	
Bobolink										B			6	
Red-winged Blackbird				B	B								1	
Eastern Meadowlark										B			6	
Yellow-headed Blackbird		S3	Rare		B								2	2
Common Grackle				B		B					B		1	
Brown-headed Cowbird				B		B		B	B		B		1	
Baltimore Oriole				B		B			B		B		1	
House Finch				B		B							1	
American Goldfinch						B							3	
Indigo Bunting						B					B		3	
Mammals[4]														
Virginia Opossum									x		x		5	
Big Brown Bat									x		x		5	
Red Bat									x		x		5	
Hoary Bat									x		x		5	
Woodchuck				x	x						x		1	
Gray Squirrel											x		7	
Deer Mouse				x	x						x		1	
Muskrat				x	x								1	
Meadow Vole				x	x					x			1	
Meadow Jumping Mouse					x				x		x		2	
Red Fox				x	x				x	x	x		1	
Raccoon				x	x	x				x	x		1	
Mink					x				x	x			2	
Striped Skunk				x	x				x		x		1	

[1] Data from: Bowles et al (1994); Names and order of list based on OMNR (1989)

[2] Data from: Bowles et al (1994)

[3] Data from: Environment Canada (1994); Woodliffe (1996); Cadman et al (1987)

[4] Data from: Bowles et al (1994); Dobbyn (1994)

[5] **COSEWIC** = Committee on the Status of Endangered Wildlife in Canada; VUL - Vulnerable; THR - Threatened; END - Endangered

[6] **NHIC** = Natural Heritage Information Centre

NHIC Provincial Rank

S1 - Extremely rare in Ontario; **S2** - Very Rare in Ontario; **S3** - Rare to uncommon in Ontario

[7] Rarity designations for: butterflies - Bowles et al (1994) - based on rarity in Elgin County; amphibians & reptiles - Bowles et al (1994); birds - Woodliffe (1996); mammals - Bowles et al (1994)

Kent County Rarity Designations (Butterflies): UK-Uncommon in Kent; RK-Rare in Kent

Birds: B - Likely to use the site for breeding; F - Likely to use the site only for feeding during the breeding season; M - Likely to use the site during the migration period (only water birds are included as possible migrants).
Many additional species will likely use the area during migration.

Appendix G - Vascular Plants Likely to Inhabit the Proposed Habitat Types

Species likely to inhabit existing agricultural lands and drains as well as surrounding woodlands are provided for sake of comparison.

SCIENTIFIC NAME	COMMON NAME	COSEWIC[1]	NHIC[2]	C[3]	W[4]	Existing Agricultural Lands and Drains	Shallow Marsh	Scattered Upland Stands of Trees, Shrubs, and Grasses	Mud Flat	Swamp	Tallgrass Prairie	Woodland
Acalypha rhomboidea (A. virginica)	THREE-SEEDED MERCURY			0	3.00					1		1
Acer negundo	BOX ELDER			0	-2.00	1	1			1		
Acer rubrum	RED MAPLE			4	0.00			1		1		
Acer saccharinum	SILVER MAPLE			5	-3.00					1		
Acer saccharum ssp. saccharum	SUGAR MAPLE;HARD MAPLE			4	3.00			1				1
Acer spicatum	MOUNTAIN MAPLE			6	3.00					1		
Achillea millefolium ssp. lanulosa	YARROW			0	3.00	1		1			1	
Acorus americanus	SWEET-FLAG;CALAMUS			8	-5.00		1					
Actaea pachypoda	*WHITE BANEBERRY;DOLL'S-EYES*			6	5.00							1
Actaea rubra	*RED BANEBERRY*			5	5.00							1
Adiantum pedatum	*MAIDENHAIR FERN*			7	1.00					1		1
Agalinis paupercula (Gerardia p.)	GERARDIA			8	-5.00		1			1		
Agalinis tenuifolia (Gerardia t.)	COMMON GERARDIA			7	-3.00		1				1	
Agrimonia gryposepala	TALL AGRIMONY			2	2.00					1		1
Agrimonia parviflora	SWAMP AGRIMONY		S3S4	4	-1.00						1	
Agrostis perennans	AUTUMN or UPLAND BENT-THIN GRASS			5	1.00			1				
Agrostis scabra	TICKLEGRASS			6	0.00		1					
Agrostis stolonifera	CREEPING BENT			0	-3.00	1	1			1	1	
Alisma plantago-aquatica	WATER-PLANTAIN			3	-5.00	1	1			1		
Allium tricoccum	*WILD LEEK;RAMPS*			7	2.00							1
Alopecurus aequalis	SHORT-AWNED FOXTAIL			7	-5.00		1					
Ambrosia artemisiifolia	COMMON RAGWEED			0	3.00			1				
Ambrosia trifida	GIANT RAGWEED			0	-1.00	1						
Amelanchier arborea	JUNEBERRY			5	3.00							1
Amelanchier laevis	SMOOTH SHADBUSH			5	5.00							1
Amphicarpaea bracteata	HOG-PEANUT			4	0.00		1			1	1	1
Andropogon gerardii	BIG BLUESTEM GRASS;TURKEYFOOT			7	1.00	1					1	
Anemone canadensis	CANADA ANEMONE			3	-3.00	1	1			1	1	
Anemone cylindrica	THIMBLEWEED			7	5.00						1	
Anemone quinquefolia	*WOOD ANEMONE*			7	0.00					1	1	1
Anemone virginiana	THIMBLEWEED			4	5.00			1				
Antennaria neglecta	CAT'S FOOT			3	5.00	1						
Antennaria parlinii (A. plantaginifolia)	SMOOTH PUSSYTOES			2	5.00	1						
Apios americana	GROUNDNUT;INDIAN-POTATO			6	-3.00		1			1	1	
Apocynum androsaemifolium	SPREADING DOGBANE			3	5.00	1		1			1	
Apocynum cannabinum (A. sibiricum)	INDIAN HEMP;HEMP DOGBANE			3	0.00	1	1	1		1	1	
Aquilegia canadensis	WILD COLUMBINE			5	1.00						1	1
Aralia nudicaulis	*WILD SARSAPARILLA*			4	3.00							1
Aralia racemosa	*SPIKENARD*			7	5.00							1
Arisaema triphyllum	JACK-IN-THE-PULPIT;INDIAN-TURNIP			5	-2.00					1		
Aronia melanocarpa (A. prunifolia)	BLACK CHOKEBERRY			7	-3.00					1		
Asarum canadense	*WILD-GINGER*			6	5.00							1
Asclepias incarnata	SWAMP MILKWEED			6	-5.00	1	1			1		
Asclepias sullivantii	SULLIVANT'S MILKWEED		S2	8	5.00	1						

SCIENTIFIC NAME	COMMON NAME	COSEWIC[1]	NHIC[2]	C[3]	W[4]	Existing Agricultural Lands and Drains	Shallow Marsh	Scattered Upland Stands of Trees, Shrubs, and Grasses	Mud Flat	Swamp	Tallgrass Prairie	Woodland
Asclepias syriaca	COMMON MILKWEED			0	5.00	1		1				
Asclepias tuberosa	BUTTERFLY-WEED			8	5.00	1					1	
Aster cordifolius	*HEART-LEAVED ASTER*			5	5.00							1
Aster dumosus	BUSHY ASTER		S2	10	-1.00						1	
Aster ericoides (Virgulus e.)	HEATH ASTER			4	4.00	1		1			1	
Aster laevis	SMOOTH ASTER			7	5.00						1	
Aster lanceolatus	EASTERN LINED ASTER			3	-3.00	1	1			1	1	
Aster lateriflorus	SIDE-FLOWERING ASTER			3	-2.00	1	1			1	1	
Aster macrophyllus	*BIG-LEAVED ASTER*			5	5.00							1
Aster novae-angliae (Virgulus n.)	NEW ENGLAND ASTER			2	-3.00	1	1			1	1	
Aster oolentangiensis (A. azureus)	PRAIRIE HEART-LEAVED ASTER			9	5.00						1	
Aster pilosus var. pilosus	HAIRY ASTER			4	2.00	1					1	
Aster praealtus	WILLOW ASTER		S2	8	-3.00						1	
Aster puniceus (A. firmus, A. lucidulus)	SWAMP ASTER			6	-5.00		1			1	1	
Aster umbellatus	TALL FLAT-TOP WHITE ASTER			6	-3.00		1			1	1	
Aster urophyllus (A. sagittifolius)	ARROW-LEAVED ASTER			6	5.00			1			1	
Athyrium filix-femina	*LADY FERN*			4	0.00					1		1
Baptisia tinctoria	WILD INDIGO		S2	10	5.00						1	
Betula alleghaniensis	YELLOW BIRCH			6	0.00					1		1
Betula papyrifera	PAPER BIRCH			2	2.00			1		1		1
Bidens cernua	NODDING BUR-MARIGOLD			2	-5.00	1	1			1		
Bidens tripartita (B. comosa, B. connata)	SWAMP TICKSEED			4	-3.00	1	1			1		
Bidens vulgata	TALL BEGGAR-TICKS			5	-3.00	1	1					
Boehmeria cylindrica	FALSE NETTLE			4	-5.00		1			1		
Brachyelytrum erectum	*LONG-AWNED WOOD GRASS*			7	5.00							1
Brasenia schreberi	WATER SHIELD			7	-5.00		1					
Bromus ciliatus	FRINGED BROME			6	-3.00	1	1			1	1	
Bromus kalmii	PRAIRIE BROME			8	0.00						1	
Bromus latiglumis	EAR-LEAVED BROME			7	-2.00		1					
Calamagrostis canadensis	BLUE-JOINT GRASS			4	-5.00	1	1			1	1	
Calamagrostis stricta (C.inexpansa)	BOG REEDGRASS			8	-4.00		1				1	
Caltha palustris	MARSH-MARIGOLD;COWSLIP			5	-5.00		1			1		
Calystegia sepium (Convolvulus s.)	HEDGE BINDWEED			2	0.00		1				1	
Campanula americana	*TALL BELLFLOWER*			8	0.00		1			1		1
Campanula aparinoides (C. uliginosa)	MARSH BELLFLOWER			7	-5.00		1			1	1	
Cardamine bulbosa	*SPRING CRESS*			8	-5.00					1		1
Cardamine concatenata (Dentaria laciniata)	*CUT-LEAVED TOOTHWORT*			6	3.00							1
Cardamine diphylla (Dentaria d.)	*TWO-LEAVED TOOTHWORT*			7	5.00							1
Cardamine pensylvanica	*PENNSYLVANIA BITTER CRESS*			6	-4.00		1			1		1
Cardamine pratensis	*CUCKOO-FLOWER*			7	-5.00					1		1
Carex albursina	SEDGE			7	5.00							1
Carex alopecoidea	SEDGE			6	-4.00		1			1		
Carex aquatilis	SEDGE			7	-5.00		1					
Carex arctata	SEDGE			5	5.00							1
Carex atherodes	SEDGE			6	-5.00		1					
Carex aurea	SEDGE			4	-4.00		1					

SCIENTIFIC NAME	COMMON NAME	COSEWIC[1]	NHIC[2]	C[3]	W[4]	Existing Agricultural Lands and Drains	Shallow Marsh	Scattered Upland Stands of Trees, Shrubs, and Grasses	Mud Flat	Swamp	Tallgrass Prairie	Woodland
Carex bebbii	SEDGE			3	-5.00	1	1			1	1	
Carex bicknellii	SEDGE		S2	10	1.00						1	
Carex blanda	SEDGE			3	0.00			1		1		
Carex brevior	SEDGE			7	0.00					1		1
Carex bromoides	SEDGE			7	-4.00					1		
Carex cephaloides	SEDGE			6	2.00							1
Carex cephalophora	SEDGE			5	3.00							1
Carex communis	SEDGE			6	5.00							1
Carex comosa	SEDGE			5	-5.00		1					
Carex crinita	SEDGE			6	-4.00		1			1		
Carex cristatella	SEDGE			3	-4.00	1	1			1		
Carex deweyana	SEDGE			6	4.00							1
Carex digitalis	SEDGE			7	5.00							1
Carex eburnea	SEDGE			6	4.00							1
Carex foenea (C. siccata)	SEDGE			8	5.00						1	1
Carex gracillima	SEDGE			4	3.00							1
Carex granularis	SEDGE			3	-4.00	1	1			1		
Carex grayi	SEDGE			8	-4.00					1		
Carex hirtifolia	SEDGE			5	5.00							1
Carex hyalinolepis	SEDGE			4	-5.00		1					
Carex hystericina	SEDGE			5	-5.00	1	1			1		
Carex interior	SEDGE			6	-5.00					1		
Carex intumescens	SEDGE			6	-4.00		1			1		
Carex lacustris	SEDGE			5	-5.00		1					
Carex lanuginosa (C. pellita)	SEDGE			4	-5.00	1	1			1	1	
Carex lasiocarpa	SEDGE			8	-5.00		1					
Carex laxiculmis	SEDGE			7	5.00							1
Carex laxiflora	SEDGE			5	0.00					1		1
Carex leptalea	SEDGE			8	-5.00					1		
Carex lupulina	SEDGE			6	-5.00		1			1		
Carex molesta	SEDGE			5	2.00	1						1
Carex muehlenbergii	SEDGE			7	5.00						1	
Carex muskingumensis	SEDGE		S2	9	-5.00					1		
Carex pedunculata	SEDGE			5	5.00							1
Carex pensylvanica	SEDGE			5	5.00						1	1
Carex plantaginea	SEDGE			7	5.00							1
Carex projecta	SEDGE			5	-4.00		1			1		
Carex pseudo-cyperus	SEDGE			6	-5.00		1					
Carex radiata (C. rosea)	SEDGE			4	5.00							1
Carex retrorsa	SEDGE			5	-5.00	1	1			1		
Carex rosea (C. convoluta)	WOOD SEDGE			5	5.00							1
Carex sartwellii	SEDGE			8	-4.00		1				1	
Carex scoparia	SEDGE			5	-3.00		1			1		
Carex sparganioides	SEDGE			5	0.00					1		1
Carex stipata	SEDGE			3	-5.00	1	1			1		
Carex stricta	SEDGE			4	-5.00		1			1	1	

SCIENTIFIC NAME	COMMON NAME	COSEWIC[1]	NHIC[2]	C[3]	W[4]	Existing Agricultural Lands and Drains	Shallow Marsh	Scattered Upland Stands of Trees, Shrubs, and Grasses	Mud Flat	Swamp	Tallgrass Prairie	Woodland
Carex tenera	SEDGE			4	-1.00		1			1	1	
Carex tribuloides	SEDGE			5	-4.00		1					
Carex umbellata	SEDGE			7	5.00						1	
Carex viridula	SEDGE			5	-5.00		1					
Carex vulpinoidea	SEDGE			3	-5.00	1	1			1		
Carpinus caroliniana	*HORNBEAM/BLUE-BEECH*			6	0.00					1		1
Carya cordiformis	*BITTERNUT HICKORY*			6	0.00					1		1
Carya laciniosa	KINGNUT or SHELLBARK HICKORY		S3	9	-3.00					1		
Carya ovata	SHELLBARK or SHAGBARK HICKORY			6	3.00							1
Caulophyllum thalictroides (C. giganteum)	*BLUE COHOSH*			6	5.00							1
Ceanothus americanus	NEW JERSEY-TEA			7	5.00						1	
Ceanothus herbaceus	NEW JERSEY-TEA			9	5.00						1	
Celastrus scandens	*AMERICAN or CLIMBING BITTERSWEET*			3	3.00			1			1	1
Celtis occidentalis	*HACKBERRY*			8	1.00							1
Cenchrus longispinus	SANDBUR;SANDSPUR			3	5.00	1						
Cephalanthus occidentalis	BUTTONBUSH			7	-5.00		1			1		
Ceratophyllum demersum	HORNWORT			4	-5.00		1					
Chelone glabra	TURTLEHEAD			7	-5.00		1			1		
Cicuta bulbifera	WATER HEMLOCK			5	-5.00	1	1			1		
Cicuta maculata	WATER HEMLOCK			6	-5.00	1	1			1	1	
Cinna arundinacea	WOOD REEDGRASS			7	-3.00					1		
Cinna latifolia	WOOD REEDGRASS			7	-4.00		1			1		
Circaea lutetiana (C. quadrisulcata)	ENCHANTER'S-NIGHTSHADE			3	3.00			1				1
Cirsium discolor	PASTURE-THISTLE			9	5.00						1	
Cirsium muticum	SWAMP-THISTLE			8	-5.00		1			1	1	
Cladium mariscoides	TWIG-RUSH			9	-5.00		1					
Clematis virginiana	VIRGIN'S BOWER			3	0.00	1	1	1		1		
Clinopodium vulgare	WILD BASIL			4	5.00			1			1	
Collinsonia canadensis	*RICHWEED*			8	0.00					1		1
Comandra umbellata	*BASTARD-TOADFLAX*			6	3.00						1	1
Conyza canadensis (Erigeron c.)	HORSEWEED			0	1.00	1		1				
Coreopsis tripteris	TALL COREOPSIS		S2	9	0.00						1	
Cornus alternifolia	ALTERNATE-LEAVED DOGWOOD			6	5.00							1
Cornus amomum (C. obliqua)	SILKY or PALE DOGWOOD			5	-4.00	1	1			1	1	
Cornus drummondii	ROUGH-LEAVED DOGWOOD			4	0.00	1		1		1		1
Cornus foemina (C. racemosa)	GRAY DOGWOOD			2	-2.00	1	1			1	1	
Cornus rugosa	*ROUND LEAVED DOGWOOD*			6	5.00							1
Cornus stolonifera	RED-OSIER DOGWOOD			2	-3.00	1	1			1	1	
Corylus americana	HAZELNUT			5	4.00			1			1	1
Corylus cornuta	BEAKED HAZELNUT			5	5.00							1
Crataegus crus-galli	COCKSPUR THORN			4	0.00	1		1				
Cryptotaenia canadensis	HONEWORT			5	0.00			1		1		
Cuscuta gronovii	COMMON DODDER			4	-3.00	1	1			1	1	
Cyperus bipartitus (C. rivularis)	UMBRELLA SEDGE			4	-4.00	1	1					
Cyperus diandrus	UMBRELLA SEDGE			6	-4.00		1					
Cyperus erythrorhizos	UMBRELLA SEDGE		S3	6	-5.00		1					

SCIENTIFIC NAME	COMMON NAME	COSEWIC[1]	NHIC[2]	C[3]	W[4]	Existing Agricultural Lands and Drains	Shallow Marsh	Scattered Upland Stands of Trees, Shrubs, and Grasses	Mud Flat	Swamp	Tallgrass Prairie	Woodland
Cyperus esculentus	CHUFA;UMBRELLA SEDGE			1	-3.00	1						
Cyperus strigosus	UMBRELLA SEDGE			5	-3.00	1	1					
Danthonia spicata	POVERTY GRASS;OATGRASS			5	5.00	1		1			1	
Decodon verticillatus	WHORLED or SWAMP LOOSESTRIFE			7	-5.00		1					
Desmodium canadense	SHOWY TICK-TREFOIL			5	1.00	1		1			1	
Desmodium glutinosum	CLUSTERED-LEAVED TICK-TREFOIL			6	5.00			1				
Desmodium nudiflorum	*NAKED TICK-TREFOIL*			7	5.00							1
Desmodium paniculatum var. dillenii	PANICLED TICK-TREFOIL			6	3.00						1	
Dicentra canadensis	*SQUIRREL CORN*			7	5.00							1
Dicentra cucullaria	*DUTCHMAN'S BREECHES*			6	5.00							1
Diervilla lonicera	*BUSH HONEYSUCKLE*			5	5.00						1	1
Dioscorea quaternata (D. villosa)	*WILD YAM*			7	1.00		1			1	1	1
Dryopteris carthusiana (D. spinulosa)	*SPINULOSE WOODFERN*			5	-2.00					1		1
Dryopteris clintoniana	*CLINTON'S WOODFERN*			7	-4.00							1
Dryopteris cristata	*CRESTED SHIELD FERN;WOODFERN*			7	-5.00					1		1
Dulichium arundinaceum	THREE-WAY SEDGE			7	-5.00		1					
Echinochloa microstachya	BARNYARD GRASS			6	-2.00		1					
Echinochloa muricata	BARNYARD GRASS			4	-5.00		1					
Echinochloa walteri	SALT-MARSH COCKSPUR GRASS		S3	8	-5.00		1					
Echinocystis lobata	WILD CUCUMBER			3	-2.00	1	1			1		
Eleocharis acicularis	SPIKE-RUSH			5	-5.00	1	1					
Eleocharis elliptica (E. tenuis)	GOLDEN-SEEDED SPIKE RUSH			7	-3.00	1	1				1	
Eleocharis erythropoda	SPIKE-RUSH			4	-5.00	1	1					
Eleocharis obtusa	SPIKE-RUSH			5	-5.00	1	1					
Eleocharis quadrangulata	FOUR-SIDED SPIKE-RUSH		S1	10	-5.00		1					
Eleocharis smallii	SPIKE-RUSH			6	-5.00	1	1			1		
Elodea canadensis	COMMON WATERWEED			4	-5.00	1	1					
Elymus canadensis	CANADA WILD-RYE			8	1.00	1					1	
Elymus riparius	RIVERBANK WILD-RYE			7	-3.00		1			1		
Elymus trachycaulus (Agropryon trachycaulum)	WHEATGRASS or SLENDER WHEAT GRASS			7	0.00	1		1			1	
Elymus virginicus	VIRGINIA WILD-RYE			5	-2.00	1	1			1	1	
Epilobium ciliatum ssp. ciliatum	*WILLOW-HERB*			3	3.00		1	1				1
Epilobium coloratum	CINNAMON WILLOW-HERB			3	-5.00	1	1			1		
Epilobium leptophyllum	FEN WILLOW-HERB			7	-5.00		1			1		
Equisetum arvense	COMMON or FIELD HORSETAIL			0	0.00	1	1	1		1	1	
Equisetum fluviatile	WATER HORSETAIL			7	-5.00	1	1			1		
Equisetum hyemale	SCOURING RUSH			2	-2.00	1	1			1	1	
Equisetum laevigatum	SMOOTH SCOURING RUSH			7	-3.00	1					1	
Equisetum sylvaticum	WOODLAND HORSETAIL			7	-3.00					1		
Equisetum variegatum	VARIEGATED SCOURING RUSH			5	-3.00	1	1			1		
Eragrostis frankii	SANDBAR LOVE GRASS			3	-3.00	1	1					
Eragrostis pectinacea	LOVE GRASS			0	0.00	1		1				
Erechtites hieracifolia	FIREWEED			2	3.00			1			1	
Erigeron annuus	ANNUAL FLEABANE			0	1.00	1		1			1	
Erigeron philadelphicus	MARSH FLEABANE			1	-3.00	1	1				1	
Erigeron pulchellus	ROBIN'S PLANTAIN			7	3.00						1	

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Erigeron strigosus	DAISY FLEABANE			0	1.00	1		1			1	
Erythronium americanum	*YELLOW TROUT LILY*			5	5.00							1
Euonymus atropurpurea	*WAHOO,BURNING-BUSH*		S3	8	1.00							1
Euonymus obovata	*RUNNING STRAWBERRY BUSH*			6	5.00							1
Eupatorium maculatum	JOE-PYE WEED			3	-5.00	1	1			1	1	
Eupatorium perfoliatum	COMMON BONESET			2	-4.00	1	1			1	1	
Eupatorium purpureum	PURPLE JOE-PYE WEED		S3	8	0.00						1	1
Eupatorium rugosum	WHITE SNAKEROOT			5	3.00					1		1
Euphorbia corollata	FLOWERING SPURGE			7	5.00						1	
Euthamia graminifolia (Solidago g.)	GRASS-LEAVED GOLDENROD			2	-2.00	1	1			1	1	
Euthamia gymnospermoides (Solidago g.)	FLAT-TOPPED GOLDENROD		S1	10	-1.00						1	
Fagus grandifolia	*AMERICAN BEECH*			6	3.00							1
Festuca subverticillata (F. obtusa)	NODDING FESCUE			6	2.00							1
Fragaria vesca	*WOODLAND STRAWBERRY*			4	4.00							1
Fragaria virginiana	WILD STRAWBERRY			2	1.00	1		1			1	1
Fraxinus americana	WHITE ASH			4	3.00			1				1
Fraxinus nigra	BLACK ASH			7	-4.00					1		
Fraxinus pennsylvanica	RED ASH			3	-3.00					1		
Fraxinus profunda (F. tomentosa)	PUMPKIN ASH		S2	9	-5.00					1		
Galium aparine	ANNUAL BEDSTRAW			4	3.00							1
Galium asprellum	ROUGH BEDSTRAW			6	-5.00		1			1		
Galium boreale	NORTHERN BEDSTRAW			7	0.00	1	1			1	1	1
Galium circaezans	WHITE WILD LICORICE			7	4.00			1				1
Galium obtusum	WILD MADDER			6	-5.00		1			1		
Galium palustre	MARSH BEDSTRAW			5	-5.00		1			1		
Galium trifidum	SMALL BEDSTRAW			5	-4.00	1	1			1		
Galium triflorum	FRAGRANT BEDSTRAW			4	2.00	1				1		1
Gaylussacia baccata	HUCKLEBERRY			8	3.00							1
Gentianopsis crinita (Gentiana c.)	FRINGED GENTIAN			8	-4.00						1	
Geranium maculatum	WILD GERANIUM			6	3.00					1		1
Geum aleppicum	YELLOW AVENS			2	-1.00	1				1		
Geum canadense	WHITE AVENS			3	0.00					1		1
Geum laciniatum	ROUGH AVENS			4	-3.00	1						
Gleditsia triacanthos	HONEY LOCUST		S2	3	0.00					1		
Glyceria borealis	NORTHERN MANNA GRASS			8	-5.00		1			1		
Glyceria grandis	REED MANNA GRASS			5	-5.00	1	1					
Glyceria striata	FOWL MANNA GRASS			3	-5.00	1	1			1		
Hackelia virginiana	*STICKSEED,BEGGAR'S LICE*			5	1.00							1
Hamamelis virginiana	WITCH-HAZEL			6	3.00							1
Helenium autumnale	SNEEZEWEED			7	-4.00		1				1	
Helianthus decapetalus	*PALE SUNFLOWER*			7	5.00							1
Helianthus divaricatus	*WOODLAND SUNFLOWER*			7	5.00						1	1
Helianthus giganteus	*TALL SUNFLOWER*			6	-3.00		1				1	1
Helianthus strumosus	PALE-LEAVED SUNFLOWER			7	5.00						1	1
Heliopsis helianthoides	FALSE SUNFLOWER			3	5.00	1						
Hepatica acutiloba	*SHARP-LOBED HEPATICA*			6	5.00							1

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Hepatica americana	*ROUND-LOBED HEPATICA*			6	5.00							1
Heracleum lanatum (H. maximum)	COW-PARSNIP			3	-3.00		1			1		
Heteranthera dubia	WATER STAR-GRASS			7	-5.00		1					
Hibiscus moscheutos (H. palustris)	ROSE or SWAMP MALLOW	VUL	S3	9	-5.00		1					
Hierochloe odorata	SWEET GRASS			5	-3.00		1				1	
Hydrophyllum virginianum	*VIRGINIA WATERLEAF*			6	-2.00					1		1
Hypericum majus	LARGER CANADA ST. JOHN'S-WORT			5	-3.00	1	1				1	
Hypericum mutilum ssp. boreale (H. boreale)	NORTHERN ST. JOHN'S-WORT			7	-5.00		1			1		
Hypericum punctatum	SPOTTED ST. JOHN'S-WORT			5	-1.00					1		
Hystrix patula (Elymus hystrix)	*BOTTLEBRUSH GRASS*			5	5.00							1
Ilex verticillata	WINTERBERRY;MICHIGAN HOLLY			5	-4.00					1		
Impatiens capensis	SPOTTED TOUCH-ME-NOT			4	-3.00	1	1			1	1	
Impatiens pallida	PALE TOUCH-ME-NOT			7	-3.00	1				1		
Iris virginica	SOUTHERN BLUE FLAG			5	-5.00	1	1					
Juglans cinerea	BUTTERNUT			6	2.00					1		1
Juglans nigra	BLACK WALNUT			5	3.00			1		1		1
Juncus alpinoarticulatus (J. alpinus)	RUSH			5	-5.00	1	1					
Juncus articulatus	JOINTED RUSH			5	-5.00	1	1					
Juncus balticus (J. arcticus ssp. b.)	RUSH			8	-5.00	1	1					
Juncus brachycephalus	RUSH			7	-5.00	1	1					
Juncus bufonius	TOAD RUSH			1	-4.00	1	1					
Juncus canadensis	CANADIAN RUSH			6	-5.00	1	1					
Juncus dudleyi	DUDLEY'S RUSH			1	0.00	1	1	1		1	1	1
Juncus nodosus	JOINT RUSH			5	-5.00	1	1					
Juncus tenuis	ROADSIDE RUSH;PATH RUSH			0	0.00	1	1	1		1	1	1
Juncus torreyi	TORREY'S RUSH			3	-3.00	1						
Juniperus virginiana	RED-CEDAR			4	3.00			1				
Lactuca biennis	TALL BLUE LETTUCE			6	0.00		1	1		1	1	
Lactuca canadensis	TALL LETTUCE			3	2.00			1			1	
Laportea canadensis	WOOD NETTLE			6	-3.00					1		
Lathyrus palustris	MARSH PEA			6	-3.00	1	1			1	1	
Leersia oryzoides	CUT GRASS			3	-5.00	1	1			1		
Leersia virginica	WHITE GRASS			6	-3.00	1				1		
Lemna minor	SMALL DUCKWEED			2	-5.00		1			1		
Lemna trisulca	STAR DUCKWEED			4	-5.00		1			1		
Lepidium virginicum	COMMON PEPPERGRASS			0	4.00	1						
Lespedeza capitata	ROUND-HEADED BUSH-CLOVER			7	3.00						1	
Lespedeza hirta	HAIRY BUSH-CLOVER			9	5.00						1	
Lespedeza intermedia	BUSH-CLOVER			8	5.00						1	
Liatris aspera	*ROUGH BLAZING STAR*		S2	10	5.00						1	1
Liatris spicata	MARSH BLAZING STAR	VUL	S3	9	0.00						1	
Lilium michiganense	MICHIGAN LILY			7	-1.00		1			1	1	
Lilium philadelphicum	WOOD LILY			8	1.00						1	1
Lindera benzoin	SPICEBUSH			6	-2.00					1		
Liparis loeselii	*LOESEL'S TWAYBLADE*			5	-4.00		1					1
Liriodendron tulipifera	TULIP TREE			8	2.00							1

SCIENTIFIC NAME	COMMON NAME	COSEWIC[1]	NHIC[2]	C[3]	W[4]	Existing Agricultural Lands and Drains	Shallow Marsh	Scattered Upland Stands of Trees, Shrubs, and Grasses	Mud Flat	Swamp	Tallgrass Prairie	Woodland
Lobelia cardinalis	CARDINAL FLOWER			7	-5.00					1		
Lobelia inflata	INDIAN TOBACCO			3	4.00	1						1
Lobelia kalmii	BOG LOBELIA			9	-5.00						1	
Lobelia siphilitica	GREAT BLUE LOBELIA			6	-4.00	1	1			1		
Lobelia spicata	PALE SPIKED LOBELIA			8	0.00						1	
Lonicera dioica	RED HONEYSUCKLE			5	3.00					1	1	1
Ludwigia palustris	WATER-PURSLANE			5	-5.00	1	1			1		
Ludwigia polycarpa	FALSE LOOSESTRIFE		S2	8	-5.00		1				1	
Luzula multiflora	COMMON WOOD RUSH			6	3.00							1
Lycopodium digitatum (L. complanatum var. flabelliforme, L. f	GROUND-CEDAR			5	5.00							1
Lycopodium lucidulum (Huperzia lucidula)	SHINING CLUBMOSS			7	-1.00					1		
Lycopodium obscurum	GROUND-PINE			6	3.00							1
Lycopus americanus	COMMON WATER HOREHOUND			4	-5.00	1	1			1	1	
Lycopus rubellus	STALKED WATER HOREHOUND		S2	9	-5.00					1		
Lycopus uniflorus	NORTHERN BUGLE WEED			5	-5.00	1	1			1	1	
Lycopus virginicus	BUGLE WEED		S2	8	-5.00		1			1		
Lysimachia ciliata	FRINGED LOOSESTRIFE			4	-3.00		1			1	1	
Lysimachia quadrifolia	WHORLED or FOUR-LEAVED LOOSESTRIFE			8	5.00						1	
Lysimachia terrestris	SWAMP CANDLES			6	-5.00		1			1		
Lysimachia thyrsiflora	TUFTED LOOSESTRIFE			7	-5.00		1			1		
Lythrum alatum	WINGED LOOSESTRIFE		S3	5	-5.00	1	1				1	
Maianthemum canadense	*WILD LILY-OF-THE-VALLEY*			5	0.00					1		1
Maianthemum racemosum (Smilacina racemosa)	*FALSE SPIKENARD*			4	3.00						1	1
Maianthemum stellatum (Smilacina stellata)	*STARRY FALSE SOLOMON-SEAL*			6	1.00						1	1
Malus coronaria	WILD, AMERICAN or SWEET CRAB			5	5.00						1	
Matteuccia struthiopteris	OSTRICH FERN			5	-3.00		1			1		
Menispermum canadense	*MOONSEED*			7	0.00					1		1
Mentha arvensis	WILD MINT			3	-3.00	1	1			1		
Mimulus ringens	MONKEY-FLOWER			6	-5.00	1	1			1		
Minuartia michauxii (Arenaria stricta)	ROCK SANDWORT			8	5.00						1	
Mitchella repens	*PARTRIDGE BERRY*			6	2.00					1		1
Mitella diphylla	*BISHOP'S CAP*			5	2.00					1		1
Mitella nuda	*NAKED MITERWORT*			6	-3.00							1
Moehringia lateriflora (Arenaria l.)	WOOD SANDWORT			7	3.00					1		1
Monarda didyma	*OSWEGO-TEA*		S3	8	3.00					1		1
Monarda fistulosa	WILD BERGAMOT			6	3.00	1		1			1	
Morus rubra	*RED MULBERRY*	THR	S2	10	1.00							1
Muhlenbergia frondosa	COMMON SATIN GRASS			5	-3.00	1	1					
Muhlenbergia mexicana	LEAFY SATIN GRASS			1	-3.00	1	1			1	1	
Muhlenbergia schreberi	NIMBLEWILL			1	0.00	1						
Myriophyllum heterophyllum	VARIOUS-LEAVED WATER-MILFOIL			7	-5.00		1					
Myriophyllum sibiricum (M. exalbescens)	SPIKED WATER-MILFOIL			6	-5.00		1					
Myriophyllum verticillatum	WATER-MILFOIL			7	-5.00		1					
Najas flexilis	SLENDER NAIAD			5	-5.00	1	1					
Nelumbo lutea	AMERICAN LOTUS		S2	10	-5.00		1					
Nuphar advena (N. lutea ssp. advena)	YELLOW POND-LILY		S3	7	-5.00		1					

SCIENTIFIC NAME	COMMON NAME	COSEWIC[1]	NHIC[2]	C[3]	W[4]	Existing Agricultural Lands and Drains	Shallow Marsh	Scattered Upland Stands of Trees, Shrubs, and Grasses	Mud Flat	Swamp	Tallgrass Prairie	Woodland
Nymphaea odorata (N. tuberosa)	SWEET-SCENTED WATERLILY			5	-5.00		1					
Nyssa sylvatica	BLACK GUM;SOUR-GUM;PEPPERIDGE		S3	9	-4.00					1		
Oenothera biennis	COMMON EVENING-PRIMROSE			0	3.00	1		1			1	
Onoclea sensibilis	SENSITIVE FERN			4	-3.00	1	1			1	1	
Orthilia secunda (Pyrola s.)	ONE-SIDED PYROLA			5	-1.00					1		
Oryzopsis asperifolia	*ROUGH-LEAVED RICE-GRASS*			6	5.00							1
Oryzopsis racemosa	*RICE-GRASS*			7	5.00							1
Osmorhiza claytonii	*HAIRY SWEET-CICELY*			5	4.00							1
Osmorhiza longistylis	*SMOOTH SWEET-CICELY*			6	4.00							1
Osmunda cinnamomea	CINNAMON FERN			7	-3.00		1			1	1	
Osmunda claytoniana	INTERRUPTED FERN			7	-1.00		1			1		
Osmunda regalis	ROYAL FERN			7	-5.00					1	1	
Ostrya virginiana	*IRONWOOD;HOP HORNBEAM*			4	4.00							1
Oxalis stricta (O. fontana in part, O. europaea)	YELLOW WOOD-SORREL			0	3.00							1
Oxypolis rigidior	COWBANE		S2	9	-5.00					1		
Panicum capillare	WITCH GRASS			0	0.00	1	1	1				
Panicum columbianum (Dichanthelium c., D. ovale)	PANIC GRASS			6	5.00			1				
Panicum implicatum (Dichanthelium i., P. acuminatum, P. lan	PANIC GRASS			2	0.00	1	1				1	
Panicum latifolium (Dichanthelium l.)	BROAD-LEAVED PANIC GRASS			8	3.00							1
Panicum oligosanthes (Dichanthelium o.)	PANIC GRASS			7	3.00						1	
Panicum virgatum	SWITCH GRASS			6	-1.00	1					1	
Parnassia glauca	GRASS-OF-PARNASSUS			8	-5.00		1					
Parthenocissus inserta (P. vitacea)	THICKET CREEPER			3	3.00	1		1		1		1
Parthenocissus quinquefolia	VIRGINIA CREEPER			6	1.00			1			1	1
Pedicularis canadensis	*WOOD-BETONY;LOUSEWORT*			7	2.00						1	1
Pedicularis lanceolata	SWAMP-BETONY;LOUSEWORT			9	-4.00					1	1	
Penstemon digitalis	FOXGLOVE BEARD-TONGUE			6	1.00	1		1				
Penstemon hirsutus	HAIRY BEARD-TONGUE			7	5.00						1	
Penthorum sedoides	DITCH STONECROP			4	-5.00	1	1			1		
Phalaris arundinacea	REED CANARY GRASS			0	-4.00	1	1			1		
Phlox divaricata	*WOODLAND PHLOX*			7	3.00							1
Phragmites australis (P. communis)	REED;GIANT BULRUSH			0	-4.00	1	1					
Phryma leptostachya	*LOPSEED*			6	5.00							1
Physalis heterophylla	CLAMMY GROUND-CHERRY			3	5.00	1		1			1	
Physocarpus opulifolius	NINEBARK			5	-2.00		1			1		
Phytolacca americana	*POKEWEED;INKBERRY*			3	1.00							1
Pilea fontana	BOG CLEARWEED			5	-3.00		1			1		
Pilea pumila	CLEARWEED			5	-3.00	1	1			1		
Pinus strobus	WHITE PINE			4	3.00			1				1
Plantago rugelii	RED-STALKED PLANTAIN			1	0.00	1		1				
Poa compressa	CANADA BLUEGRASS			0	2.00	1		1				
Poa palustris	FOWL MEADOW GRASS			5	-4.00	1	1			1	1	
Poa pratensis	KENTUCKY BLUEGRASS			0	1.00	1		1			1	
Podophyllum peltatum	*MAY APPLE;MANDRAKE*			5	3.00							1
Polygala paucifolia	*FLOWERING-WINTERGREEN;GAY-WINGS*			6	3.00							1
Polygonatum biflorum	*SOLOMON-SEAL*			8	3.00							1

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Polygonatum pubescens	*DOWNY SOLOMON SEAL*			5	5.00							1
Polygonum achoreum	SMARTWEED			0	5.00	1						
Polygonum amphibium	WATER SMARTWEED			5	-5.00		1					
Polygonum hydropiper	WATER-PEPPER			4	-5.00	1	1			1		
Polygonum hydropiperoides	WATER-PEPPER			4	-5.00		1			1		
Polygonum lapathifolium	NODDING SMARTWEED			2	-4.00	1	1				1	
Polygonum pensylvanicum	PINKWEED;BIGSEED SMARTWEED			3	-4.00	1	1					
Polygonum punctatum	SMARTWEED			4	-5.00		1			1		
Polygonum sagittatum	ARROW-LEAVED TEAR-THUMB			5	-5.00		1					
Polygonum scandens	FALSE BUCKWHEAT			3	0.00	1	1			1		
Polygonum virginianum (Tovara v.)	*JUMPSEED*			6	0.00					1		1
Polystichum acrostichoides	*CHRISTMAS FERN*			5	5.00							1
Pontederia cordata	PICKEREL WEED			7	-5.00		1					
Populus balsamifera	BALSAM POPLAR;HACKMATACK			4	-3.00					1		
Populus deltoides	COTTONWOOD			4	-1.00	1				1		
Populus grandidentata	BIG-TOOTHED or LARGE-TOOTHED ASPEN			5	3.00			1				1
Populus tremuloides	QUAKING ASPEN			2	0.00			1		1		1
Potamogeton amplifolius	LARGE-LEAVED PONDWEED			5	-5.00		1					
Potamogeton foliosus	LEAFY PONDWEED			4	-5.00		1					
Potamogeton gramineus	PONDWEED			4	-5.00		1					
Potamogeton natans	PONDWEED			5	-5.00		1					
Potamogeton pectinatus	SAGO PONDWEED			4	-5.00		1					
Potamogeton richardsonii	RICHARDSON'S PONDWEED			5	-5.00		1					
Potamogeton zosteriformis	FLAT-STEMMED PONDWEED			5	-5.00		1					
Potentilla anserina	SILVERWEED			5	-4.00	1	1					
Potentilla arguta	TALL or PRAIRIE CINQUEFOIL			7	4.00			1			1	
Potentilla norvegica	ROUGH CINQUEFOIL			0	0.00	1	1	1			1	
Potentilla palustris	MARSH CINQUEFOIL			7	-5.00		1					
Potentilla simplex	OLD-FIELD or COMMON CINQUEFOIL			3	4.00	1		1				
Prenanthes alba	WHITE LETTUCE;RATTLESNAKE-ROOT			6	3.00							1
Prenanthes altissima	TALL WHITE LETTUCE			5	3.00							1
Prenanthes racemosa	GLAUCOUS WHITE LETTUCE			10	-3.00						1	1
Proserpinaca palustris	MERMAID-WEED			7	-5.00		1			1		
Prunella vulgaris ssp. lanceolata	HEAL-ALL			5	5.00	1	1	1			1	
Prunus americana	AMERICAN WILD PLUM			6	5.00			1				
Prunus nigra	CANADA PLUM			4	4.00			1				
Prunus pensylvanica	FIRE or PIN CHERRY			3	4.00			1				
Prunus serotina	WILD BLACK CHERRY			3	3.00			1				
Prunus virginiana	CHOKE CHERRY			2	1.00	1		1				
Pteridium aquilinum	BRACKEN FERN			2	3.00	1		1			1	1
Pycnanthemum virginianum	COMMON MOUNTAIN MINT			8	-4.00						1	
Pyrola elliptica	LARGE-LEAVED SHINLEAF			5	5.00							1
Quercus alba	WHITE OAK			6	3.00							1
Quercus bicolor	SWAMP WHITE OAK			8	-4.00					1		
Quercus macrocarpa	BUR OAK			5	1.00			1				1
Quercus palustris	PIN OAK		S3	9	-3.00					1		

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Quercus rubra	RED OAK			6	3.00			1				1
Quercus shumardii	SHUMARD OAK	VUL	S3	7	-5.00					1		
Quercus velutina	BLACK OAK			8	5.00						1	1
Ranunculus abortivus	SMALL-FLOWERED BUTTERCUP			2	-2.00					1		
Ranunculus fascicularis	EARLY BUTTERCUP			9	3.00						1	
Ranunculus flabellaris	YELLOW WATER CROWFOOT			7	-5.00		1			1		
Ranunculus hispidus var. caricetorum (R. septentrionalis)	SWAMP BUTTERCUP			5	-5.00		1			1		
Ranunculus longirostris	WHITE WATER CROWFOOT			5	-5.00		1					
Ranunculus pensylvanicus	BRISTLY CROWFOOT			3	-5.00	1	1			1		
Ranunculus recurvatus	HOOKED CROWFOOT			4	-3.00		1			1		
Ranunculus sceleratus	CURSED CROWFOOT			2	-5.00	1	1			1		
Ratibida pinnata	YELLOW CONEFLOWER		S2S3	9	5.00	1					1	
Rhus aromatica	FRAGRANT SUMAC			8	5.00			1				
Rhus glabra	SMOOTH SUMAC			7	5.00			1			1	
Rhus radicans ssp. negundo (Toxicodendron r. ssp. n.)	POISON-IVY			5	-1.00					1		
Rhus radicans ssp. rydbergii (R. rydbergii, Toxicodendron r.)	POISON-IVY			0	0.00	1	1	1		1	1	
Rhus typhina	STAGHORN SUMAC			1	5.00	1		1			1	
Ribes americanum	WILD BLACK CURRANT			4	-3.00		1			1	1	
Ribes cynosbati	PRICKLY or WILD GOOSEBERRY			4	5.00	1		1			1	1
Ribes hirtellum	SWAMP GOOSEBERRY			6	-3.00					1		
Ribes triste	SWAMP RED CURRANT			6	-5.00					1		
Rorippa palustris	YELLOW CRESS			3	-5.00	1	1			1		
Rosa blanda	WILD ROSE			3	3.00	1		1			1	
Rosa carolina	PASTURE ROSE			6	4.00	1		1			1	
Rosa palustris	SWAMP ROSE			7	-5.00	1	1			1		
Rosa setigera	PRAIRIE ROSE	VUL	S3	5	2.00			1			1	
Rubus allegheniensis	COMMON BLACKBERRY			2	2.00			1			1	1
Rubus flagellaris	NORTHERN DEWBERRY			4	4.00			1			1	
Rubus hispidus	SWAMP DEWBERRY			6	-3.00					1		
Rubus idaeus (R. strigosus)	WILD RED RASPBERRY			0	-2.00	1	1			1		
Rubus pubescens	DWARF RASPBERRY			4	-4.00					1		
Rudbeckia hirta	BLACK-EYED SUSAN			0	3.00	1		1			1	
Rudbeckia laciniata	CUT-LEAVED CONEFLOWER			7	-4.00		1			1		
Rumex orbiculatus	GREAT WATER DOCK			6	-5.00		1			1		
Sagittaria cuneata	ARUM-LEAVED ARROWHEAD			7	-5.00	1	1					
Sagittaria latifolia	COMMON ARROWHEAD			4	-5.00	1	1			1		
Sagittaria rigida	STIFF ARROWHEAD			6	-5.00		1					
Salix amygdaloides	PEACH-LEAVED WILLOW			6	-3.00	1	1			1		
Salix bebbiana	BEBB'S or BEAKED WILLOW			4	-4.00		1			1		
Salix discolor	PUSSY WILLOW			3	-3.00	1	1			1	1	
Salix eriocephala	WILLOW			4	-3.00	1	1			1	1	
Salix exigua (S. interior)	SANDBAR WILLOW			3	-5.00	1	1			1		
Salix humilis	UPLAND or PRAIRIE WILLOW			7	3.00						1	
Salix lucida	SHINING WILLOW			5	-4.00	1				1		
Salix nigra	BLACK WILLOW			6	-5.00	1				1		
Salix petiolaris	SLENDER or MEADOW WILLOW			3	-4.00	1	1			1		

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Sambucus canadensis	ELDERBERRY;COMMON ELDER			5	-2.00	1	1			1		
Sambucus racemosa (S. pubens)	RED-BERRIED ELDER			5	2.00			1				
Sanicula canadensis var. canadensis	*BLACK SNAKEROOT*			7	2.00							1
Sanicula marilandica	*BLACK SNAKEROOT*			5	3.00					1		1
Sanicula odorata (S. gregaria)	BLACK SNAKEROOT			6	-1.00					1		
Sassafras albidum	SASSAFRAS			6	3.00	1						1
Saururus cernuus	LIZARD'S-TAIL		S3	8	-5.00		1					
Schizachne purpurascens	FALSE MELIC			6	2.00							1
Schizachyrium scoparium (Andropogon s.)	LITTLE BLUESTEM GRASS			7	3.00	1					1	
Scirpus acutus (Schoenoplectus a.)	HARDSTEM BULRUSH			6	-5.00		1					
Scirpus atrovirens	BULRUSH			3	-5.00	1	1			1		
Scirpus cyperinus	WOOL-GRASS;BULRUSH			4	-5.00	1	1			1		
Scirpus microcarpus (S. rubrotinctus)	BULRUSH			4	-5.00	1	1					
Scirpus pendulus	BULRUSH			3	-5.00	1					1	
Scirpus pungens (S. americanus, Schoenoplectus p.)	THREE-SQUARE;BULRUSH			6	-5.00	1	1					
Scirpus validus (Schoenoplectus tabernaemontani, Schoeno	SOFTSTEM BULRUSH			5	-5.00	1	1					
Scutellaria galericulata	COMMON SKULLCAP			6	-5.00	1	1			1		
Scutellaria lateriflora	MAD-DOG SKULLCAP			5	-5.00	1	1			1		
Senecio pauperculus	BALSAM RAGWORT			7	-1.00						1	
Sisyrinchium montanum	MOUNTAIN BLUE-EYED-GRASS			4	-1.00	1					1	
Sisyrinchium mucronatum	SLENDER BLUE-EYED-GRASS			10	-2.00						1	
Sium suave	WATER-PARSNIP			4	-5.00	1	1			1		
Smilax ecirrhata	*UPRIGHT CARRION-FLOWER*		S3?	6	5.00							1
Smilax hispida (S. tamnoides)	BRISTLY GREEN-BRIER			6	0.00			1		1		
Smilax lasioneura	*CARRION-FLOWER*			5	5.00							1
Solanum ptycanthum	BLACK NIGHTSHADE			3	5.00	1		1				
Solidago altissima	TALL GOLDENROD			1	3.00	1		1			1	
Solidago caesia	*BLUE-STEMMED GOLDENROD*			5	3.00							1
Solidago canadensis	CANADA GOLDENROD			1	3.00	1		1			1	
Solidago flexicaulis	*BROAD-LEAVED GOLDENROD*			6	3.00							1
Solidago gigantea	LATE GOLDENROD			4	-3.00	1	1			1	1	
Solidago hispida	*WHITE GOLDENROD*			7	5.00			1				1
Solidago juncea	EARLY GOLDENROD			3	5.00	1		1				
Solidago nemoralis	OLD-FIELD GOLDENROD			2	5.00	1		1			1	
Solidago ohioensis	OHIO GOLDENROD			10	-5.00						1	
Solidago riddellii	RIDDELL'S GOLDENROD		S3	10	-5.00						1	
Solidago rigida	STIFF GOLDENROD		S3	9	4.00						1	
Solidago rugosa	ROUGH GOLDENROD			4	-1.00	1	1			1	1	
Sorghastrum nutans	INDIAN GRASS			8	2.00	1					1	
Sparganium emersum (S. chlorocarpum)	GREEN-FRUITED BUR-REED			5	-5.00	1	1			1		
Sparganium eurycarpum	COMMON BUR-REED			3	-5.00	1	1			1		
Spartina pectinata	CORDGRASS			7	-4.00	1	1				1	
Sphenopholis intermedia	SLENDER WEDGEGRASS			6	0.00			1		1		1
Spiraea alba	MEADOWSWEET			3	-4.00	1	1			1	1	
Spiraea tomentosa	HARDHACK;STEEPLEBUSH			5	-3.00		1			1		
Spirodela polyrhiza	GREAT DUCKWEED			4	-5.00		1			1		

SCIENTIFIC NAME	COMMON NAME	COSEWIC[1]	NHIC[2]	C[3]	W[4]	Existing Agricultural Lands and Drains	Shallow Marsh	Scattered Upland Stands of Trees, Shrubs, and Grasses	Mud Flat	Swamp	Tallgrass Prairie	Woodland
Sporobolus asper	ROUGH DROPSEED		S1S2	2	5.00	1		1				
Sporobolus cryptandrus	SAND DROPSEED			2	4.00	1						
Sporobolus neglectus	SMALL RUSH GRASS			1	5.00	1						
Sporobolus vaginiflorus	SHEATHED RUSH GRASS			1	5.00	1						
Stachys hispida	HEDGE NETTLE			7	-4.00	1	1				1	
Staphylea trifolia	*BLADDERNUT*			7	0.00					1		1
Stellaria longifolia	LONG-LEAVED CHICKWEED			2	-4.00		1			1	1	
Strophostyles helvula	WILD BEAN		S3	8	-1.00						1	
Symphoricarpos albus	SNOWBERRY			7	4.00			1				1
Symplocarpus foetidus	SKUNK-CABBAGE			7	-5.00					1		
Taenidia integerrima	YELLOW-PIMPERNEL			9	5.00						1	1
Teucrium canadense ssp. canadense	WOOD SAGE			6	-2.00	1	1				1	
Teucrium canadense ssp. viscidum	WOOD SAGE			6	-3.00		1				1	
Thalictrum dasycarpum	PURPLE MEADOW-RUE			8	-2.00		1			1		
Thalictrum dioicum	*EARLY MEADOW-RUE*			5	2.00							1
Thalictrum pubescens	HAIRY MEADOW-RUE			5	-2.00	1	1			1		
Thalictrum revolutum	WAXY MEADOW-RUE		S2	9	0.00					1	1	
Thelypteris palustris	MARSH FERN			5	-4.00	1	1			1	1	
Tiarella cordifolia	*FOAMFLOWER,FALSE MITERWORT*			6	1.00					1		1
Tilia americana	LINDEN;BASSWOOD			4	3.00			1				1
Triadenum fraseri (Hypericum f.)	MARSH ST. JOHN'S-WORT			7	-5.00		1			1		
Trillium erectum	*STINKING BENJAMIN*			6	1.00					1		1
Trillium grandiflorum	*COMMON TRILLIUM*			5	5.00							1
Triosteum aurantiacum (T. perfoliatum var. a.)	HORSE-GENTIAN			7	5.00							1
Typha angustifolia	NARROW-LEAVED CAT-TAIL			3	-5.00	1	1			1		
Typha latifolia	BROAD-LEAVED CAT-TAIL			3	-5.00	1	1			1		
Ulmus americana	WHITE or AMERICAN ELM			3	-2.00	1	1	1		1		1
Ulmus rubra	RED or SLIPPERY ELM			6	0.00			1		1		1
Urtica dioica ssp. gracilis	NETTLE			2	-1.00	1	1			1		
Utricularia vulgaris	GREAT BLADDERWORT			4	-5.00		1					
Uvularia grandiflora	*LARGE-FLOWERED BELLWORT*			6	5.00							1
Uvularia sessilifolia	*MERRYBELLS*			7	1.00							1
Vaccinium angustifolium	*BLUEBERRY*			6	3.00							1
Vaccinium pallidum	*BLUEBERRY*			9	5.00						1	1
Vallisneria americana	EEL GRASS;TAPE GRASS;WILD CELERY			6	-5.00		1					
Verbena hastata	BLUE VERVAIN			4	-4.00	1	1				1	
Verbena urticifolia	WHITE VERVAIN			4	-1.00	1	1			1		
Vernonia gigantea (V. altissima)	TALL IRONWEED			7	0.00					1	1	
Vernonia missurica	MISSOURI IRONWEED		S1S3	?	?	1						
Veronica scutellata	MARSH SPEEDWELL			7	-5.00	1	1			1		
Veronicastrum virginicum	*CULVER'S ROOT*		S2	10	0.00	1					1	1
Viburnum acerifolium	*MAPLE-LEAVED ARROW-WOOD*			6	5.00							1
Viburnum lentago	*NANNYBERRY,SHEEPBERRY*			4	-1.00		1	1		1		1
Viburnum rafinesquianum	*DOWNY ARROW-WOOD*			7	5.00			1				1
Viburnum trilobum	HIGHBUSH CRANBERRY			5	-3.00		1			1		
Viola adunca	*SAND VIOLET*			8	1.00						1	1

SCIENTIFIC NAME	COMMON NAME	COSEWIC[1]	NHIC[2]	C[3]	W[4]	Existing Agricultural Lands and Drains	Shallow Marsh	Scattered Upland Stands of Trees, Shrubs, and Grasses	Mud Flat	Swamp	Tallgrass Prairie	Woodland
Viola conspersa	*DOG VIOLET*			4	-2.00	1				1		1
Viola cucullata	MARSH VIOLET			5	-5.00	1	1			1		
Viola fimbriatula	VIOLET			7	5.00						1	
Viola pubescens (V. eriocarpa, V. pensylvanica)	YELLOW VIOLET			5	4.00			1				
Viola rostrata	*LONG-SPURRED VIOLET*			6	3.00							1
Viola sagittata	ARROW-LEAVED VIOLET			9	-2.00						1	
Viola sororia	COMMON BLUE VIOLET			4	1.00	1		1			1	
Vitis aestivalis	SUMMER GRAPE			7	3.00	1		1				
Vitis riparia	RIVERBANK GRAPE			0	-2.00	1	1			1	1	
Waldsteinia fragarioides	*BARREN-STRAWBERRY*			5	5.00							1
Wolffia borealis (W. punctata)	DOTTED WATER MEAL			4	-5.00		1			1		
Wolffia columbiana (W. arrhiza)	COMMON WATER MEAL			4	-5.00		1			1		
Xanthium strumarium	COMMON COCKLEBUR			2	0.00	1	1					
Zanthoxylum americanum	PRICKLY-ASH			3	5.00			1		1		
Zizia aurea	GOLDEN ALEXANDERS			7	-1.00		1			1	1	
	TOTALS					**211**	**260**	**98**	**0**	**253**	**189**	**187**

Table compiled by Wasyl Bakosky (Natural Heritage Information Centre), Al Woodliffe (Ministry of Natural Resources), and Don Sutherland (Natural Heritage Information Centre)

[1] - VUL = Vulnerable; THR = Threatened

[2] - NHIC Provincial Rank: [S1 - Extremely rare in Ontario; S2 - Very rare in Ontario; S3 - Rare to uncommon in Ontario; S4 - Common and apparently secure in Ontario; S5 - Very common and demonstrably se

[3] - Coefficient of Conservatism:"numeric value between 0 and 10 which indicates the degree of faithfulness a plant displays to a specific habitat or set of environmental conditions. 'Conservative' plant species, such as those which are only found in relatively pristine natural habitats such as bogs or prairies, are assigned a high coefficient of conservatism; other plant species which grow in a wide variety of habitats and can tolerate high levels of cultural disturbance are assigned low values".

[4] - Wetness Index: Lower negative numbers imply greater correlation with wetland conditions; Higher positive numbers imply greater correlation with upland conditions

SUGAR BEETS

	Per acre		Per ha
YIELD	19.40 t		43.50 T
PRICE	$ 56		$ 61
Gross Revenue	$ 1,082		$ 2,675
Operating Costs			
Seed, plants	$ 40		$ 99
Pesticides	$ 95		$ 235
Fertilizer	$ 125		$ 309
Hired labour	$ -		$ -
Fuel, repairs, custom work	$ 227		$ 561
Irrigation	$ -		$ -
Containers, storage, transport	$ 130		$ 321
Crop insurance	$ -		$ -
Misc.	$ 14		$ 35
Total Operating Cost	$ 631		$ 1,559
Net Operating Revenue	$ 451		$ 1,115

Yield Data

1995 not available
1996
1997
1998
Avg

Source: OMAFRA
Notes : 18.6% sugar content

CARROTS

	Per acre	
YIELD	50,000 lb	
PRICE	$ 0.05	
Gross Revenue	$ 2,500	
Operating Costs		
Seed, plants	$ 202	
Pesticides	$ 161	
Fertilizer	$ 72	
Hired labour	$ 68	
Fuel, repairs, custom work	$ 133	
Irrigation	$ -	
Containers, storage, transport	$ 98	
Crop insurance	$ 159	
Misc.	$ 50	
Total Operating Cost	$ 943	
Net Operating Revenue	$ 1,558	

Yield Data		Ont
	1995	54,119
	1996	39,925
	1997	34,308
	1998	44,115
	Avg	43,117

Source: OMAFRA
Notes :

	Per ha
YIELD	56.06 T
PRICE	$ 110
Gross Revenue	$ 6,178
Operating Costs	
Seed, plants	$ 499
Pesticides	$ 398
Fertilizer	$ 178
Hired labour	$ 168
Fuel, repairs, custom work	$ 329
Irrigation	$ -
Containers, storage, transport	$ 242
Crop insurance	$ 392
Misc.	$ 124
Total Operating Cost	$ 2,329
Net Operating Revenue	$ 3,849

Yield Data

1995	60.68
1996	44.76
1997	38.46
1998	49.46
Avg	48.34

Source:
Notes :

TOMATO - Fresh

	Per acre	
YIELD	20,000 lb	
PRICE	$ 0.26	
Gross Revenue	$ 5,200	
Operating Costs		
Seed, plants	$ 464	
Pesticides	$ 95	
Fertilizer	$ 90	
Hired labour	$ 1,891	
Fuel, repairs, custom work	$ 123	
Irrigation	$ 160	
Containers, storage, transport	$ 1,529	
Crop insurance	$ 270	
Misc.	$ 50	
Total Operating Cost	$ 4,672	
Net Operating Revenue	$ 528	

Yield Data		Ont
	1995	23,345
	1996	
	1997	
	1998	
	Avg	23,345

Source: OMAFRA
Notes : Trucking costs added assuming $8/ton.

Appendix H
LAKE ST CLAIR WETLAND RESTORATION PROJECT

4/25/2001

	Per ha
YIELD	22.42 T
PRICE	$ 573
Gross Revenue	$ 12,849
Operating Costs	
Seed, plants	$ 1,147
Pesticides	$ 235
Fertilizer	$ 222
Hired labour	$ 4,673
Fuel, repairs, custom work	$ 304
Irrigation	$ 395
Containers, storage, transport	$ 3,778
Crop insurance	$ 667
Misc.	$ 124
Total Operating Cost	$ 11,545
Net Operating Revenue	$ 1,305

Yield Data

1995
1996
1997
1998
Avg

Source:
Notes :

TOMATO - Processing

	Per acre		Per ha
YIELD	55,000 lb		61.66 T
PRICE	$ 0.06		$ 132
Gross Revenue	$ 3,300		$ 8,154
Operating Costs			
Seed, plants	$ 696		$ 1,720
Pesticides	$ 133		$ 329
Fertilizer	$ 90		$ 222
Hired labour	$ 473		$ 1,168
Fuel, repairs, custom work	$ 246		$ 608
Irrigation	$ 160		$ 395
Containers, storage, transport	$ 220		$ 544
Crop insurance	$ 270		$ 667
Misc.	$ 50		$ 124
Total Operating Cost	$ 2,338		$ 5,777
Net Operating Revenue	$ 962		$ 2,378

Yield Data		Ont	
	1995	61,045	68.44
	1996	56,545	63.40
	1997	53,638	60.14
	1998	67,091	75.22
	Avg	59,580	66.80

Source: OMAFRA, Ohio State University

Notes : No processed tomato costs from OMAFRA, so that costs were based on fresh tomatoes assuming:

12,000 plants/acre
labour cost reduced by 75%
field operations doubled
higher pesticide costs
lower marketing cost

PEPPERS

	Per acre		Per ha
YIELD	10,000 lb		11.21 T
PRICE	$ 0.26		$ 573
Gross Revenue	$ 2,600		$ 6,425
Operating Costs			
Seed, plants	$ 234		$ 578
Pesticides	$ 82		$ 203
Fertilizer	$ 61		$ 151
Hired labour	$ 527		$ 1,302
Fuel, repairs, custom work	$ 115		$ 284
Irrigation	$ 160		$ 395
Containers, storage, transport	$ 453		$ 1,119
Crop insurance	$ 138		$ 341
Misc.	$ 50		$ 124
Total Operating Cost	$ 1,820		$ 4,497
Net Operating Revenue	$ 780		$ 1,927

Yield Data		Ont	
	1995	14,695	16.47
	1996	11,770	13.20
	1997	13,270	14.88
	1998	17,013	19.07
	Avg	14,187	15.91

Source: OMAFRA
Notes :

GRAIN CORN

	Per acre		Per ha
YIELD	137 bu		8.60 T
PRICE	$ 3.60		$ 142
Gross Revenue	$ 493		$ 1,960
Operating Costs			
Seed, plants	$ 47		$ 116
Pesticides	$ 45		$ 111
Fertilizer	$ 66		$ 163
Hired labour	$ -		$ -
Fuel, repairs, custom work	$ 50		$ 124
Irrigation	$ -		$ -
Containers, storage, transport	$ -		$ -
Crop insurance	$ 13		$ 32
Misc.	$ 12		$ 30
Total Operating Cost	$ 233		$ 576
Net Operating Revenue	$ 260		$ 1,384

Yield Data		Kent Co.	
	1995	126	7.91
	1996	133	8.35
	1997	133	8.32
	1998	155	9.73
	Avg	137	8.58

Source: OMAFRA, Ag Canada (prices)
Notes :

W. WHEAT

	Per acre		Per ha
YIELD	66 bu		4.44 T
PRICE	$ 4.00		$ 147
Gross Revenue	$ 264		$ 1,394
Operating Costs			
Seed, plants	$ 35		$ 86
Pesticides	$ 5		$ 12
Fertilizer	$ 55		$ 136
Hired labour	$ -		$ -
Fuel, repairs, custom work	$ 46		$ 114
Irrigation	$ -		$ -
Containers, storage, transport	$ -		$ -
Crop insurance	$ 10		$ 25
Misc.	$ 9		$ 22
Total Operating Cost	$ 160		$ 395
Net Operating Revenue	$ 104		$ 998

Yield Data		Kent Co.	
	1995	79	5.34
	1996	48	3.24
	1997	68	4.54
	1998	69	4.64
	Avg	66	4.44

Source: OMAFRA, Ag Canada (prices)
Notes :

SOY BEANS

	Per acre		Per ha
YIELD	43 bu		2.89 T
PRICE	$ 9.20		$ 338
Gross Revenue	$ 696		$ 1,719
Operating Costs			
Seed, plants	$ 34		$ 84
Pesticides	$ 45		$ 111
Fertilizer	$ 14		$ 35
Hired labour	$ -		$ -
Fuel, repairs, custom work	$ 27		$ 67
Irrigation	$ -		$ -
Containers, storage, transport	$ -		$ -
Crop insurance	$ 10		$ 24
Misc.	$ 7		$ 17
Total Operating Cost	$ 137		$ 338
Net Operating Revenue	$ 559		$ 1,381

Yield Data	Kent Co.	
1995	45	3.03
1996	39	2.62
1997	39	2.65
1998	48	3.23
Avg	43	2.88

Source: OMAFRA, Ag Canada (prices)
Notes :

HEMP (fibre)

	Per acre		Per ha
YIELD	3.86 t		8.65 T
PRICE	$ 163		$ 180
Gross Revenue	$ 630		$ 1,557
Operating Costs			
Seed, plants	$ 165		$ 408
Pesticides	$ -		$ -
Fertilizer	$ 70		$ 173
Hired labour	$ -		$ -
Fuel, repairs, custom work	$ 176		$ 435
Irrigation	$ 176		$ 435
Containers, storage, transport	$ 175		$ 432
Crop insurance	$ -		$ -
Misc.	$ 23		$ 57
Total Operating Cost	$ 785		$ 1,940
Net Operating Revenue	$ -155		$ -383

Yield Data
1995
1996
1997
1998
Avg

Source: OMAFRA
Notes :

HEMP (grain)

	Per acre		Per ha
YIELD	800 lb		0.90 T
PRICE	$ 0.45		$ 992
Gross Revenue	$ 660		$ 1,631
Operating Costs			
Seed, plants	$ 132		$ 326
Pesticides	$ -		$ -
Fertilizer	$ 70		$ 173
Hired labour	$ -		$ -
Fuel, repairs, custom work	$ 221		$ 546
Irrigation	$ 221		$ 546
Containers, storage, transport	$ 128		$ 316
Crop insurance	$ -		$ -
Misc.	$ 22		$ 54
Total Operating Cost	$ 794		$ 1,962
Net Operating Revenue	$ -134		$ -331

Yield Data
1995
1996
1997
1998
Avg

Source: OMAFRA
Notes :

APPENDIX I

Detailed Results of Economic Evaluation, Travel Cost Data, and Benefit Transfer Analysis

Detailed Results of Economic Evaluation

		Base Case	Next to existing wetlands	Nearshore to LSC	Inland from LSC	Large no. of cells (6)	Small no. of cells (3)	Two Sites	With Mud Flats	Mud Flats, Wooded Swamp, Prairie
3% Discount Rate										
Business performance	Avg	$3.9	$3.9	$3.9	$3.9	$2.1	$5.8	-$3.5	$11.9	$2.3
	S.D.	$5.9	$5.9	$5.9	$5.9	$6.1	$5.6	$6.8	$7.0	$12.8
Reg. net benefit	Avg	$46.3	$46.3	$46.3	$46.3	$44.4	$48.1	$38.8	$54.2	$44.6
	S.D.	$9.3	$9.3	$9.3	$9.3	$9.4	$9.1	$9.9	$9.9	$14.5
Provincial net benefit	Avg	$20.5	$22.1	$14.8	$26.4	$15.0	$24.6	$11.7	$94.7	$189.9
	S.D.	$15.5	$15.5	$16.1	$15.0	$15.4	$15.2	$15.8	$29.0	$54.5
Reg. eco. change	Avg	-$244.1	-$293.9	-$223.6	-$265.1	-$130.6	-$314.0	-$201.0	-$129.4	$151.7
	S.D.	$188.6	$188.1	$191.1	$187.5	$197.3	$178.7	$201.5	$190.6	$198.1
Provincial eco. change	Avg	-$348.7	-$419.9	-$319.4	-$378.7	-$186.5	-$448.5	-$287.1	-$184.8	$216.8
	S.D.	$269.4	$268.7	$273.0	$267.8	$281.9	$255.2	$287.9	$272.3	$283.1
5% Discount Rate										
Business performance	Avg	$3.7	$3.7	$3.7	$3.7	$1.9	$5.5	-$3.6	$11.3	$0.7
	S.D.	$6.3	$6.3	$6.3	$6.3	$6.6	$6.1	$7.4	$8.1	$14.0
Reg. net benefit	Avg	$45.3	$45.3	$45.3	$45.3	$43.5	$47.1	$38.0	$52.9	$42.3
	S.D.	$9.2	$9.2	$9.2	$9.2	$9.4	$9.0	$10.0	$10.3	$15.7
Provincial Net benefit	Avg	-$7.1	-$5.1	-$14.6	$0.5	-$13.8	-$2.6	-$16.0	$62.9	$149.8
	S.D.	$15.6	$15.5	$16.7	$15.4	$16.1	$15.3	$16.2	$29.1	$52.8
Reg. eco. change	Avg	-$219.3	-$266.6	-$195.0	-$243.9	-$102.8	-$282.9	-$180.2	-$109.9	$168.6
	S.D.	$197.4	$188.3	$199.7	$199.2	$213.4	$185.1	$200.9	$197.4	$196.7
Provincial eco. change	Avg	-$313.3	-$380.8	-$278.6	-$348.4	-$146.9	-$404.1	-$257.4	-$157.0	$240.9
	S.D.	$282.0	$269.0	$285.3	$284.6	$304.9	$264.5	$287.0	$282.0	$281.0
7% Discount Rate										
Business performance	Avg	$3.4	$3.4	$3.4	$3.4	$1.6	$5.2	-$3.8	$10.6	$1.4
	S.D.	$6.1	$6.1	$6.1	$6.1	$6.4	$5.9	$7.2	$7.4	$12.4
Reg. net benefit	Avg	$43.8	$43.8	$43.8	$43.8	$42.0	$45.6	$36.6	$51.0	$41.8
	S.D.	$8.6	$8.6	$8.6	$8.6	$8.7	$8.4	$9.3	$9.3	$12.9
Provincial net benefit	Avg	-$37.6	-$35.3	-$47.8	-$27.6	-$45.4	-$32.2	-$47.4	$29.1	$119.3
	S.D.	$16.5	$16.0	$16.9	$14.8	$16.8	$16.1	$16.9	$30.1	$50.3
Reg. eco. change	Avg	-$181.7	-$225.6	-$150.9	-$212.0	-$70.2	-$249.0	-$132.7	-$76.8	$195.8
	S.D.	$202.9	$174.2	$207.6	$203.1	$193.3	$184.2	$190.1	$203.5	$206.5
Provincial eco. change	Avg	-$259.6	-$322.3	-$215.6	-$302.9	-$100.3	-$355.7	-$189.5	-$109.7	$279.7
	S.D.	$289.8	$248.8	$296.6	$290.2	$276.1	$263.2	$271.6	$290.7	$295.0

		Base Case	Next to existing wetlands	Nearshore to LSC	Inland from LSC	Large no. of cells (6)	Small no. of cells (3)	Two Sites	With Mud Flats	Mud Flats, Wooded Swamp, Prairie
5% Discount Rate, No US Capital Grant										
Business performance	Avg	$3.5	$3.5	$3.5	$3.5	$1.7	$5.4	-$3.8	$11.3	$1.2
	S.D.	$6.3	$6.3	$6.3	$6.3	$6.6	$6.1	$7.4	$7.8	$13.3
Reg. net benefit	Avg	$44.9	$44.9	$44.9	$44.9	$43.1	$46.7	$37.6	$52.6	$42.5
	S.D.	$9.2	$9.2	$9.2	$9.2	$9.4	$9.0	$10.0	$9.8	$14.8
Provincial net benefit	Avg	-$200.5	-$194.0	-$224.7	-$179.4	-$215.6	-$190.0	-$213.1	-$133.4	-$60.7
	S.D.	$24.3	$24.6	$28.5	$21.6	$25.2	$24.4	$24.5	$34.5	$51.3
Reg. eco. change	Avg	-$217.1	-$271.3	-$189.7	-$241.0	-$106.8	-$289.4	-$173.9	-$106.9	$168.8
	S.D.	$196.3	$204.9	$192.5	$195.3	$207.6	$195.9	$207.8	$198.8	$200.6
Provincial eco. change	Avg	-$310.1	-$387.6	-$271.0	-$344.3	-$152.6	-$413.5	-$248.4	-$152.7	$241.1
	S.D.	$280.4	$292.7	$274.9	$279.0	$296.6	$279.9	$296.8	$284.0	$286.6
5% Discount Rate, $6,000/ac for Vegetable Land										
Business performance	Avg	$3.5	$3.5	$3.5	$3.5	$1.7	$5.3	-$3.9	$11.0	$1.8
	S.D.	$6.5	$6.5	$6.5	$6.5	$6.8	$6.2	$7.6	$8.0	$13.4
Reg. net benefit	Avg	$45.0	$45.0	$45.0	$45.0	$43.2	$46.9	$37.6	$52.5	$43.3
	S.D.	$10.6	$10.6	$10.6	$10.6	$10.7	$10.4	$11.3	$11.5	$15.1
Provincial net benefit	Avg	-$29.2	-$27.1	-$44.9	-$14.3	-$35.8	-$24.2	-$38.3	$41.5	$132.2
	S.D.	$17.5	$17.6	$19.1	$16.8	$17.6	$17.5	$17.9	$29.3	$55.8
Reg. eco. change	Avg	-$144.4	-$194.4	-$93.5	-$192.7	-$29.6	-$218.7	-$101.9	-$33.8	$243.3
	S.D.	$197.2	$183.0	$198.9	$196.5	$196.8	$192.5	$192.7	$196.1	$201.2
Provincial eco. change	Avg	-$206.3	-$277.6	-$133.6	-$275.3	-$42.3	-$312.5	-$145.6	-$48.2	$347.6
	S.D.	$281.7	$261.5	$284.2	$280.7	$281.1	$274.9	$275.3	$280.2	$287.5

Notes: 1. Avg. = average; S.D. = 2 standard deviations
2. All values are 1,000s of 1999 dollars expressed in annualized form.

Travel Cost Data Analysis from the 1996 Survey on the Importance of Nature to Canadians

Waterfowl Hunting Values

Purpose

This working paper documents findings of an econometric analysis of waterfowl hunting data from the 1996 Survey of the Importance of Nature to Canadians. The analysis was completed to estimate the value to hunters of waterfowl hunting activity. These estimates provide information to support the assessment of hunting activity that will take place on the proposed 1,000-acre wetland near Lake St Clair. The analysis reported here is preliminary and exploratory in nature.

Data

The 1996 Survey of the Importance of Nature to Canadians, administered by Statistics Canada, was delivered as a supplement to its monthly Labour Force Survey. The survey methodology is described in a summary report (Enviroment Canada, 1999). Data used for this analysis include responses from locations in Canada east of British Columbia. Data series come primarily from section F of the survey dealing with waterfowl hunting.

There were 844 records in the original database. A sample size of 322 was obtained once records were screened. The following exclusionary criteria were used to screen the data:

- Age less than 20, or age >20 and income = $0
- Non response regarding direct travel cost (F8), contingent value (F9), travel distance (F14), trip frequency (F15), number of days of hunting (F16), and income (H1)
- Respondent hunted at more than one site (aggregate travel costs were requested for all sites whereas distance and use variables were provided for one or two specific sites. An accurate cost variable could therefore only be constructed for respondents using only one site)
- Excessively high travel distance for a one day trip suggests a multiple purpose trip (e.g. 650+ km)
- Respondent reported a direct cost of zero suggesting that he was a guest in a hunting party where others covered the costs (i.e. not the primary decision-maker)

Approach

Two models were estimated from the survey data: a travel cost demand curve and a model explaining stated willingness to pay (WTP). Both models were estimated by OLS regression using individual observations of hunter activity.

In the travel cost demand curve, the quantity of hunting was measured as days of hunting per season (rather than hunting trips) at the most commonly used site. The cost of a hunting day was calculated as the sum of the following items:

- Average daily values of reported direct costs for travel, accommodation, supplies, and other items (e.g. park entry fees)
- The cost associated with travel time was estimated as follows:
  [(distance in km to site) * 2 / (80 km per hour)]*[(annual income)/(2,000 hrs work per year)]
- The onsite opportunity cost of time was calculated as follows:
  (hours per recreation day) * (annual income)/(2,000 hrs work per year)
  where hours per recreation day is assumed to be 4 for same day trips and 8 for overnight trips

There was no information from the survey describing site attributes or hunter success, both of which are normally included in travel cost demand curves. A dummy variable was used as a proxy measure of the respondent's interest in hunting. It was set to 1.0 if investment in equipment exceeded 0.2 percent of annual income.

The general form of the travel cost model is:

(days of hunting per season) = f(cost of a hunting day, annual of hunter, investment dummy)

Several functional forms of this model were tested. Regression results are reported below along with estimates of average consumer surplus per day for each model. The estimates of consumer surplus shown hear are averages of the consumer surplus estimated for each hunter by integration of the demand curve above the current travel cost for each hunter.

TABLE I.1
DEMAND CURVE MODELS*

Model	$D = a+bX+cY+dZ$	$D = aX^bY^cZ^d$	$D = e^{(a+bX+cY+dZ)}$
Constant (a)	1.6151 (12.140)	2.299 (8.472)	1.6566 (12.666)
Total Cost /day (b)	-0.0052 (-4.727)	-0.5045 (-6.436)	-0.0058 (-5.664)
Income/1,000 (c)	0.0020 (0.516)	0.2856 (2.887)	0.0067 (1.630)
Invest. Dummy (d)	0.7593 (6.500)	0.7191 (6.322)	0.9150 (6.552)
R^2	0.1641	0.2091	0.1714
f statistic	20.874	28.116	22.002
Degrees of freedom	319	319	319
Consumer surplus/day	$376	$74 **	$174

* t-scores in brackets

** A choke price beyond which hunting is zero is assumed in order to allow integration of the log/log curve. The choke price is assumed to be 3 times each hunters cost per day (based on a comparison of mean WTP and trip cost).

The log/log model appears to provide the best fit. After adjustment to account for the missing substitute site cost variable, the daily CS value would be $52.

In the WTP model, total WTP for each hunter was regressed against total days of hunting in the season, annual income and the investment dummy. Regression results for alternative specifications of the model are shown in Table I.2. Average consumer surplus is $23.51. Average WTP per day of hunting was estimated as total WTP divided by total days of hunting within the season.

TABLE I.2
WILLINGNESS TO PAY MODELS *

Model	$W = a+bX+cY+Dz$	$W = aX^bY^cZ^d$	$W = e^{(a+bX+cY+dZ)}$
Constant (a)	-11.3533 (-0.463)	-3.0486 (-1.571)	-1.2846 (-1.365)
Total days of hunting (b)	2.6259 (4.105)	0.9370 (1.760)	0.0554 (2.258)
Income/1,000 (c)	2.3784 (2.802)	0.5333 (1.454)	0.0507 (1.557)
Invest. Dummy (d)	69.7614 (3.268)	0.4418 (1.533)	0.4156 (0.508)
R^2	0.1055	0.0166	0.0.232
f statistic	12.543	1.792	2.523
Degrees of freedom	319	319	319

* t-scores in brackets

Benefit Transfer Analysis

A benefits transfer method is used to estimate benefits at the site of a planning study, the "policy" site, using measures of benefit or benefit functions developed from valuation research at other study sites. Measures of benefit derived from travel cost models (TCM) and contingent value models (CVM) and hedonic studies are all potential candidates for benefits transfer. The approach is promising because it creates the possibility of effective benefit assessment without the cost and time requirements of primary valuation research. A benefit transfer study requires the following general steps (Boyle and Bergstrom, 1992):

1. Characterise the value to be assessed at the policy site: nature of the amenity and the environmental changes generating the benefit, ex ante or ex post evaluation, policy context (property rights, direction of change, et.c), use and/or non-use values, characteristics of uses, socio-economic attributes of users and market area.
2. Identify appropriate study sites: locate studies of comparable sites through literature searches, key informant interviews, examination of reference lists for review articles, etc.
3. Assess transferability of study findings: are the policy and study site commodities and populations similar? Are the policy setting and decision variables similar?
4. Assess the quality of the transfer benefits: Is the study methodologically sound? Are sufficient data and results reported to support benefits transfer? Are the estimates of benefit biased?
5. Collect supplementary data and compute benefits: Decide on the approach to benefit transfer. Collect any additional data required for the policy site (or the study site) to facilitate benefit transfer calculations. Complete benefit transfer calculations including sensitivity analyses.

Three levels of analysis are possible with benefits transfer: application of unit values of benefit to the policy site without adjustment, adjustment of unit values to reflect policy site characteristics, and estimation of a benefits using mean values for the policy site variables in an estimated benefit function (Desvouges et al., 1992). The opportunity to adjust the reported benefits or benefit functions will depend on the nature of analysis at the study site. For instance, a varying parameter TCM is well suited to benefits transfer since the sensitivity of model coefficients to amenity quality or other site characteristics is explicitly estimated (e.g. Smith and Desvouges, 1986; Ecologistics Ltd., 1990). Hedonic models considering resource based site characteristics such as wetlands may also well suited to benefits transfer (Bardeski, 1998, describes four hedonic studies that consider wetlands).

A comparative analysis of studies at sites that are comparable to the policy site may inform the analyst about appropriate adjustments to make in benefit transfer analysis. For instance, Walsh, Johnson and McKean (1992) compare the results of 287 recreation studies using regression analysis. They conclude that user day values from TCM studies that omit travel time cost should be increased by about 30%, and those that omit the cost of substitute sites should be reduced by 30%.

The simple application of unadjusted unit values in evaluations is a long-standing practice, but more methodical benefits transfer is relatively new. A number of issues arise in its application (Boyle and Bergstrom, 1992; Desvouges et al., 1992):

- It is often difficult to find studies that match the policy area conditions, and studies that do exist are often poorly documented and rarely structured to accommodate benefits transfer.
- Much is usually left to the analysts' judgement in conducting benefits transfer, but there are no guidelines to assist in the exercise and no means of verifying the resulting benefits.
- Benefits transfer methods do not help the analyst determine the size of the market. This will depend on factors such as the population density and dispersion about the site, the affected resource services and the presence of substitute sites.

Review of Valuation Studies

A large number of studies were reviewed in the process of developing background information for valuation of waterfowl hunting and nature appreciation. Many of these are summarized in Table ___, and an assessment is made of the applicability of findings from each study in the current analysis. Studies chosen for use in the benefits transfer analysis are discussed at greater length in Table ___.

Reported daily values for CS are adjusted for inflation to 1999 Canadian prices and further adjustments are made where possible to account for recognized sources of bias. Adjusted values for hunting range from $24 to $166; with the most realistic values lying in the $50 to $60 range. A separate estimate of CS was made for this study using the 1996 Canadian wildlife survey data (see Appendix _). This analysis also supports the use of a value in the $50 to $60 range, say $55. There were fewer reliable sources of estimates for CS for nature viewing and for general outdoor recreation that could be applied at the policy site. Available information supports a value of $25/day for birding and about $10 for general outdoor recreation.

TABLE I.3
LITERATURE SELECTED FOR BENEFIT TRANSFER ANALYSIS

Reference	Site Comparison	Comments on Estimation	Adjusted Consumer Surplus (Cdn $ 1999)
Waterfowl Hunting			
Gum, R.L. and W.E. Martin, 1975	State-wide survey of recreation in Arizona. No site attributes are considered. Region is markedly different in character and study is dated. CS values are of general interest only.	Generalised TCM estimated by OLS. Regressors describe substitutes but travel time and travel cost are entered separately and CS values do not appear to incorporate travel time coefficient (→ - ve bias); onsite time is not considered (→ - ve bias).	$64 per household trip (days/trip and persons/trip are not reported). Assuming 2 persons and 1 day per trip yields $32/day. This estimate is subject to considerable downward bias.

TABLE I.3
LITERATURE SELECTED FOR BENEFIT TRANSFER ANALYSIS

Reference	Site Comparison	Comments on Estimation	Adjusted Consumer Surplus (Cdn $ 1999)
Hammack, J. and G.M. Brown, 1974	Survey of recreation across 7 western states. Region is markedly different in character and study is dated. CS values are of general interest only.	Mail-back CVM survey with WTA and WTP questions; open-ended WTP question; open-ended questions are subject to non-response bias; trip cost payment vehicle; OLS estimation of a WTP model; insufficient information to assess likely sources of bias.	Average and marginal values calculated from reported data: Average CS/day = $166; Marginal CS/day = $80
Johnson, C.W. and R.L. Linder, 1986	State-wide survey of recreation in S. Dakota. No site attributes are considered. Region is markedly different in character and study is dated. CS values are of general interest only.	Survey method modelled after Hammack and Brown (see comments above); a WTP model was not estimated but average CS values are reported for 3 zones.	Total CS was somewhat higher than Hammack and Brown but average days/season were more than double. CS/day varies from $24 to $35.
Roy, P., 1986	Site is in the same local area and wetland qualities are similar; Walpole wetlands are much larger than the policy site; dyked wetlands should provide a similar hunting experience especially if congestion is controlled as is proposed.	Walpole hunting permit records were used to construct a zonal TCM. Values for direct expenditures are assumed values; travel time is considered for trips > 150 km and on-site time is not accounted for in the cost variable (→ - ve bias); days per trip is not known; substitute sites are not accounted for (→ + ve bias). OLS estimation of the TCM.	Estimates of CS/trip are $62 for Can'n hunters and $190 for US hunters. Adjustment for substitutes yields $43 and $133. These values are low due to the treatment of time costs but may be high estimates of value per day if many hunters take overnight trips. Assuming hunters are all locals a value of $50 to $60 is appropriate for the policy site.
Sorg, C.F. and L.J. Nelson, 1987	State-wide survey of waterfowl hunting in Idaho. No site attributes are considered. Region is different in character.	Generalised zonal TCM model estimated using OLS; cost variable did not account for on-site costs (→ -ve bias); no substitutes (→ + ve bias). CVM based on an iterative bidding question starting at 20% of reported trip cost with a trip cost payment vehicle; subject to starting point bias (→ - ve bias).	CS/day from TCM = $74; correction for substitutes yields $52/day; appropriate upward adjustment for on-site costs not known. CS/day from CVM = $31; this is probably low
Nature Viewing/Birding			
Boyle, K.J., B. Roach, and D.G. Waddington, 1998	Not applicable, survey was national in scope and geographic scale of the analysis was regional. Non-negative values were not obtained for the Great Lakes region.	Dichotomous choice question; ML estimation of a probit model; trip cost payment vehicle; no obvious sources of bias in the method.	Reported CS values range from $3/day to $54/day. 7 of 19 estimated values fell between $26 and $32/day.

TABLE I.3
LITERATURE SELECTED FOR BENEFIT TRANSFER ANALYSIS

Reference	Site Comparison	Comments on Estimation	Adjusted Consumer Surplus (Cdn $ 1999)
Hvenegaard, G.T., J.R. Butler, and D.K. Krystofiak, 1989	Peelee is physically close to the policy site but is larger, more diverse and is located strategically to attract migrating birds. Visitation by birders numbers in the 10s of thousands. Policy site is much more modest and will not function as a primary destination for birders but as one stop on a circuit including Peelee, Rondeau and other sites.	Little detail provided on method; open-ended CVM question; trip cost payment vehicle; mean values are reported but no modelling was completed; question structure suggest some misspecification bias relating to birding in the Park vs birding in the area; reported frequency of a 'double the cost' answer suggests elicitation bias (i.e. CS estimate < true WTP).	Reported CS values are $350/trip or $103/day. Average trip length is 5.4 days of which 63% (3.4 days) was spent in Peelee area. CS/day seems to be a ratio of mean CS/trip and days in Peelee. If total trip length is used (5.4 days less 1-day allowance for travel) then CS/day is $58. About ½ of this value, say $25, is a reasonable figure to use for the policy site.
Walsh, R.G., 1986	Various studies are reviewed and summarized. Comparability can not be assessed.	Various studies are reviewed and summarized.	Wildlife viewing - $58/day
General Recreation			
Kreutzwiser, R., 1981	Study site is in the same region and is similar in proximity to larger population centres but it is larger and features a diversity of habitats and uses. Generally a higher quality site.	Onsite interviews and mail back quest're used to develop TCM data base. CS values developed directly from the data using the Pearse method. No TCM model was estimated. Travel time accounted for in the cost variable but onsite time not considered (→ -ve bias).	Mean CS per party per trip = $89; Mean part size is 2.5; assuming 1-day/trip yields a CS of $35.6/day. This is biased downward but the true value is too high for the policy site due to quality differences.
Roy, P., 1986	Site is in the same local area but fishing occurs in open waters of Lake St Clair, not in dyked wetlands where fishing will be of much lower quality.	Creel survey data were used to construct a zonal TCM. Values for direct expenditures are assumed values and time is not accounted for in the cost variable (→ - ve bias); one day per trip assumed (→ + ve bias); substitute sites are not accounted for (→ + ve bias). OLS estimation of the TCM.	Estimates of CS/day are $22 for Canadian anglers and $80 for US anglers. Adjustment for substitutes yields $15 and $56. Anglers in the wetland will likely all be locals. In light of the lower quality, the lower Canadian value, $15, is reasonable for the policy site.
Walsh, R.G., 1986	Various studies are reviewed and summarized. Comparability can not be assessed.	Various studies are reviewed and summarized.	Hiking - $23 to $42/day Rural outdoor recreation - $14 to $30/day

APPENDIX J

Class Environmental Assessment Considerations

Class EA Screening

The following sections (1.1 to 1.6) correspond to the MNR's Class Environmental Assessment (EA), Field Environmental Planning Process (FEPP) Step 1 – Project Proposal (Subsection 1.1 to 1.6).

1.1 Purpose and Rationale

The primary purpose of the restoration project is to create additional wetland habitat to serve as staging habitat for use by waterfowl and other wetland-dependent birds in the Eastern Lake St. Clair area. The secondary purpose is to provide other environmental benefits, and to generate social and economic benefits. These benefits are expected to occur over a variety of spatial and temporal scales. A wetland size of 1,000 acres is proposed.

1.2 Project Alternatives

The project proposes the restoration project of 1,000 acres of shallow marsh and is likely to include four dyked cells, an office structure on site, hunting on 50 percent of the site and various levels of programming for visitors. Depending on design considerations, dyked cells could range from 3 to 6. The wetland could also be located on two separate sites within the Study Area with a maximum cumulative area of 1,000 acres. The office structure could range from a small office to a larger office with interpretative facilities. Additional habitats that would also be considered are mudflats, tallgrass prairie and wooded swamp components as outlined in Section 4.2 of this report. Project alternatives outlined in this section refer to a number of geographic locations -- "North Part", "South Part", "Offshore", "Nearshore", and "Inland" as defined in Section 1.5.

Within the defined Study Area a variety of locations for this 1,000-acre marsh restoration proposal are being considered based on the following factors:

1. Location within the Study Area:
    - North Part of the Study Area (refer to Figure 3-1)
    - South Part of the Study Area (refer to Figure 3-1)
2. Location with respect to lake areas versus inland areas
    - Offshore
    - Land areas adjacent to Lake St. Clair shore (nearshore)
    - Inland
3. Wetlands Located on One Site versus Two Sites

Including the "null alternative," this produced a list of seven possible alternatives as outlined in Table J.2 and described as follows:

- **Alternative 1: Wetland located in North Part of Study Area – Nearshore (NORTH PART/NEARSHORE SECTOR)**
  This wetland would be restored in the defined nearshore area adjacent to Lake St. Clair, the Chenal Ecarte, existing wetlands, and areas up to 3 km inland.
- **Alternative 2: Wetland located in South Part of Study Area – Nearshore (SOUTH PART/NEARSHORE SECTOR)**
  The wetland would be restored in the defined nearshore area adjacent to Lake St. Clair, adjacent to the North bank of the Thames River, existing wetlands, and areas up to 3 km inland.
- **Alternative 3: Wetland located in North Part of Study Area – Inland (NORTH PART/INLAND SECTOR)**
  The wetland would be restored in the defined inland areas (3 to 8 km inland). The wetland site would also be located in the vicinity of a drain with an adequate volume of water for pumping/water level management purposes.
- **Alternative 4: Wetland located in South Part of Study Area – Inland (SOUTH PART/INLAND SECTOR)**
  The wetland would be restored in the defined inland areas (3 to 8 km inland). The wetland site would also be located in the vicinity of a drain or water source with an adequate volume of water for pumping/water level management purposes.
- **Alternative 5: Wetland located on two sites in Study Area (TWO SITES/ANY SECTOR)**
  This alternative allows for two wetland units to be restored on separate sites within the Study Area. These two wetland units could both be restored in the same Sector of the Study Area (e.g. the North Part/Nearshore Sector) or the two wetland units could be restored in separate Sectors (e.g. one wetland unit in the North Part/Inland Sector and the other wetland unit in the South Part/Nearshore Sector).
- **Alternative 6: Wetland Located in Offshore Areas**
  The wetland would be restored in the offshore areas of Lake St. Clair and would involve the construction of dykes in the shallow water areas of Lake St. Clair.
- **Alternative 7: Null Alternative**
  No wetlands would be restored.

TABLE J.2
PROJECT ALTERNATIVE RATINGS

Alternative/Criteria	Feasibility	Effectiveness[1]	Estimated Costs[2]	Environmental Effects
Alternative 1 – Wetland Located in North Part/ Nearshore (One Site)	High	High	Medium	Low
Alternative 2 – Wetland Located in South Part/ Nearshore Sector (One Site)	High	High	Medium	Low

TABLE J.2
PROJECT ALTERNATIVE RATINGS

Alternative/Criteria	Feasibility	Effectiveness$^{(1)}$	Estimated Costs$^{(2)}$	Environmental Effects
Alternative 3 – Wetland Located in North Part/ Inland Sector (One Site)	Medium-High Dependent on adequate supply of water	Medium-High	Medium	Low
Alternative 4 – Wetland Located in South Part/ Inland Sector (One Site)	Medium-High Dependent on adequate supply of water	Medium-High	Medium	Low
Alternative 5 – Wetland Located in up to Two Sectors (Two Sites)	Medium-High	Medium-High	Medium-High Higher costs due to separate pump facilities	Low
Alternative 6 – Wetland Located in Offshore Areas	Low Significant approvals and engineering considerations	Low This alternative would only enhance wetland in offshore areas. No wetlands would be restored	High Engineering and construction costs would be very high	Low
Alternative 7 – Null Alternative. No Wetlands Restored	N/A	Low	N/A	Low

Effectiveness (1)	There are more benefits of restoring a wetland in the "nearshore areas", as outlined in Table 8.3; therefore, "effectiveness" is generally rated HIGH for nearshore areas and MEDIUM-HIGH for inland areas. However, a wetland restoration project in an inland area location would still provide significant ecological, social and economic benefits.
Estimated Costs (2)	Costs for Alternatives 1 to 4 are considered relatively the same. With the exception of higher land costs in the nearshore areas, the cost of restoring 1,000 acres of marsh with similar habitats and facilities would be the same in all four alternatives (1-4).

1.3 Project Evaluation

The seven project alternatives were examined using four criteria. Each alternative was rated (High, Medium, Low) using the four criteria in determining the overall value of each alternative. The list of criteria and ratings were as follows:

- Feasibility - Low (least desired) to High (most desired)
- Effectiveness - Low (least desired) to High (most desired)
- Estimated Costs - Low (most desired) to High (least desired)
- Environmental Effects - Low (most desired) to High (least desired)

The Project Alternative Ratings are outlined in Table J.2.

At this point, Alternative 6 - "Wetland Located in Offshore Areas" was dropped due to its high costs, low feasibility, and overall limited effectiveness. Creation of dyked cells in these offshore areas would only enhance existing wetland habitats; no new wetland habitat would be restored using this alternative.

1.4 Identification of Project Status

This project will be planned in accordance with the Field Environmental Planning Procedure for Category B – Class EA for Small Scale MNR Projects.

Projects in this wetland restoration proposal may involve:

- Access points and docks
- Access roads
- Dams and dykes
- Shoreline and streambank stabilization
- Water-related excavation, dredge, and fill activities
- Ponds

1.5 Definition of the Study Area

The delineation of the general Study Area is shown in Figure 1-1. It is located along the eastern shoreline of Lake St. Clair and includes the majority of the former Dover Township in what is now the Municipality of Chatham-Kent. The Study Area generally encompasses the shore areas and the land area approximately 8 km inland from the Lake St. Clair shoreline. It is bordered by the Thames River to the South and the Sydenham River to the North. Communities within the Study Area include the Town of Mitchell's Bay and the villages of Bagnall, Baldoon, Bearline, Bradley, Dover Centre, Electric and Grande Pointe.

Definitions – Project Alternatives

The **North** and **South Parts** of the Study Area are generally defined as those areas lying North or South of City Road 37 (8th Concession Road).

Offshore Areas are generally those areas West of the Lake St. Clair shore area with open access to the lake (water level and flow not restricted by dykes). Generally, the ARDA dyke system defines this Lake St. Clair shore area; however, in recent years an extensive offshore area of exposed sand, mudflats and emergent marsh vegetation has developed. It is this generally undyked land/water transitional area that is considered "Offshore".

Nearshore Areas are defined as those areas between the Lake St. Clair and Chenal Ecarte shore areas to approximately 3 km inland. In many areas the ARDA dyke system defines this shore area. Most of the areas used for vegetable production are included in this nearshore area.

Inland Areas are defined as those lands from 3 km to 8 km inland from the Lake St. Clair shore area. These lands are predominantly in corn or soybean rotation.

1.6 First Notice

A notice of the project will proceed following the completion of the report entitled "A Socio-Economic and Environmental Effects Study of a Proposed 1,000 Acre Wetland Restoration Project Near Lake St. Clair, In Southwestern Ontario".

APPENDIX K

Literature Review for Wetland Valuations

Reference	Summary	Comments
Waterfowl Hunting		
Bardecki, M., 1988	WTP, opportunity cost, and cumulative impact analysis was completed for Greenock swamp in Southwestern Ontario. A CVM survey was used to determine WTP. Most respondents were not well informed about wetlands in general or about the study site. Nature appreciation and non-use values were considered.	Low response rates and starting point bias were significant problems in the survey. Use values required for the policy site were not estimated. Results are not applicable.
Bishop, R.C. and T.A. Heberlein, 1979	Mail-back surveys sent to 3 samples of hunters holding a goose permit in a region of Wisconsin. One sample provided data for TCM, one for CVM and the final group was offered varying amounts of cash to sell their permits. CS values were compared.	Estimated CS values are per permit, not per day. Results are not applicable.
Charbonneau, J.J. and M.J. Hay 1978	Based on a U.S. national survey of hunters in 1974 asking about waterfowl hunting experiences and the value of additional waterfowl harvested. The analysis was disaggregated by waterfowl type (geese, dabbling, and diving ducks) and by flyway.	[STILL LOOKING FOR ORIGINAL REFERENCE]
Doss, C.R. and S.J. Taff, 1996	The value of urban wetlands to residents was inferred from premiums paid for homes located near wetlands. Study area was Ramsay Co., Minnesota. Large sample size and model had good explanatory power ($r^2 = 0.76$). Proximity to wetland variables was significant.	Study in an urban setting, and does not consider the use values required for the policy site. Results are not applicable.
Gum, R.L. and W.E. Martin, 1975	Mail-back quest're to residents of Arizona to develop generalised TCMs for 8 recreation activities in 7 zones. Aggregate regional demand curves are developed from regression results and used to estimate CS.	Individual sites are not identified and the study area differs in many respects from the policy site. Results may be useful as a benchmark.
Hammack, J. and G.M. Brown, 1974	A CVM mail-back survey of waterfowl hunters in 7 western states. Open ended questions for both WTP and WTA. WTP model includes number of days, hunting success and other personal variables but no site-specific variables.	Individual sites are not identified and the study area differs in many respects from the policy site. Results may be useful as a benchmark.
Hovde, B. and J.A. Leitch, 1994	Eight categories of benefit are quantified using various methods and then evaluated. CS of users is estimated as 40% of user expenditures.	Does not provide a primary estimate of CS for hunting. Results are not applicable.
Johnson, C.W., and R.L. Linder, 1986	Methodology like that of Hammack and Brown applied to 3 regions of S. Dakota. Authors did not develop a model to explain WTP but report CS/day.	Individual sites are not identified and study area differs in many respects from the policy site. Results may be useful as a benchmark.

Reference	Summary	Comments
Kosz, M., 1996	Study measures WTP to protect existing 11,500 ha wetland from hydroelectric development. Relied on a contingent value interview survey with an open-ended valuation question. WTP disaggregated into existence, bequest and option value.	The cultural, economic and ecological contexts differ markedly from the policy site. Results are not applicable.
Kreutzwiser, R., 1981	WTP estimated directly from travel cost information obtained by interview and mail back surveys. WTP for each income class assumed to equal (maximum. observed travel costs)-(average travel cost). All users are lumped together (fishing, hunting, birding).	Values may provide a useful reference point. An explicit travel cost demand curve model is not used in the analysis. Results are not applicable to hunting.
Roy, P., 1986 (see also: van Vuren, W. and P. Roy, 1993)	Wetland values estimated for waterfowl hunting, hunt club operations, fishing, and trapping. These are compared to values generated by agriculture on converted land. CS for hunting estimated using a zonal TCM.	CS per day is estimated for hunters. Study site and policy site are in the area. Results are directly applicable.
Stokoe, P., J. Roots, and B. Walters, 1989	WTP, opportunity cost and cumulative impact analysis was completed for Minudie Dykelands; a freshwater marsh construction proposal. WTP approach was similar to that of Bardecki (1988) with modifications in keeping with valuation of a planned rather than an existing site. Hunting, nature appreciation and non-use values were considered.	Small sample size and starting point bias were problems identified in the report. Other sources of potential bias include payment vehicle, elicitation method, and mis-specification. Results are not applicable.
Sorg, C.F., and L.J. Nelson, 1987	CVM and TCM study of waterfowl hunting in Idaho. Telephone survey with iterative bid WTP question. TCM is a generalised zonal model including quality and substitute variables. Average net WTP estimated with TCM was \$22.25 per trip and \$32.79 per trip with standard costs and reported costs, respectively. A WTP value of \$16.87 per trip was estimated by CVM.	Study covers a variety of sites but model is generally well structured and alternative estimates of value per user day are estimated. Results are useful for BT to the policy site.
Whitehead, J.C., 1990	CVM study to determine WTP to preserve a hardwood forest wetland in Kentucky. Dichotomous choice question format with explicit consideration of substitute wetlands.	Study deals with a wooded wetland, does not estimate explicit use values and considers preservation rather than construction. Results are not applicable.
Nature Viewing/Birding		
Boyle, K.J., B. Roach, and D.G. Waddington, 1998	CVM used to estimate CS per day for wildlife watching. Dichotomous choice question were asked in an interview survey attached to the 1996 National Survey of Fishing, Hunting and Wildlife-Associated Recreation.	Non-negative values were not obtained for the Great Lakes area or the Northeast. Results from other areas are informative.
Hvenegaard, G.T., J.R. Butler, and D.K. Krystofiak, 1989	Onsite interviews were used to characterise birder recreation and elicit WTP using an open-ended question.	Study site is within the same region but differs markedly in quality from the policy site. Results are applicable with adjustment.
Signorello, G., 1998	CVM used to value birding activity at a Mediterranean wetland of international significance. CVM question was a double-bounded dichotomous choice question.	The cultural, economic and ecological contexts differ markedly from the policy site. Results are not applicable.

Reference	Summary	Comments
General Recreation		
Bergstrom, J.C., J.R.Stoll, J.P.Titre, and V.L.Wright, 1990	Combined onsite interview and mail-back CVM survey of recreationist in Louisiana to develop CS values for wetland preservation. Dichotomous choice question involving 3 levels of protection.	Study wetland is quite different from the policy site and specific uses were not valued. Results are not applicable.
Costanza, R., S.C. Farber, and J.Maxwell, 1989	Values of 4 wetland functions are estimated for a Louisiana coastal wetland. Farber's (1988) analysis is used for recreation values (see below).	See Farber below.
Farber, S., 198_	Zonal TCM and CWM used to evaluate coastal wetlands in Louisiana. Self-administered mail-back quest're. Alternative estimates of CS were made and compared to WTP values. Payment card WTP question. Different uses were not differentiated.	Study wetland is quite different from the policy site and specific uses were not valued. Results are not applicable.
Kreutzwiser, R., 1981	WTP estimated directly from travel cost information obtained by interview and mail back surveys. WTP for each income class assumed to equal (maximum. observed travel costs)-(average travel cost). All users are lumped together (fishing, hunting, birding).	Values may provide a useful reference point. An explicit travel cost demand curve model is not used in the analysis.
Roy, P., 1986	Zonal TCM analysis of angling.	CS per day is estimated for anglers. Study site and policy site are in the area. Results are directly applicable.
Walsh, R.G., 1986	A comprehensive text on resource valuation. Summarizes user-day values from a variety of sources as well as other information used in valuation work.	Insufficient detail provided to support BT analysis. Useful for value benchmarks.